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Intersection with State Highway

THE MONTICELLO ESTATE ROAD

By J. L. HARRISON

Senior Highway Engineer, U. S. Bureau of Public Roads

MONTICELLO, the home of Thomas Jefferson, has for many years been one of our more notable national shrines. The home itself stands on a high hill from which a magnificent view is to be had of the surrounding country in all directions. Tradition states that it was built there for a purpose, for Jefferson was far from popular with the British and during the Revolutionary war lived for years with a price on his head! Be that as it may, his home at Monticello, erected on the eminence on which it stands, and surrounded by the charming lawns which have been developed about it, is the Mecca of thousands of American citizens who visit this spot every year to pay silent tribute to one of the really great men of our early history.

$30,000 Expenditure Authorized.—Having in mind the national aspects of this spot, the Seventy-third Congress authorized the expenditure of $30,000 for the improvement of the roads within the grounds of the Monticello Estate. The purpose was evident—to provide a better connection between the State road system and the Monticello home which is about a mile and a quarter from the main highway. There had, of course, always been a road between these two points and it had, in recent years, been considerably improved. Still it did not provide that degree of dignity which is consistent with the approach to the home of a patriot his countrymen desired to honor. For there should be fitness in all things —in highways no less than in other things.

We have not always realized this. That is not strange. Our recent attention has been directed toward developing enough highways to keep out of the mud. We are just beginning to realize that highways can serve other purposes—that they can be made beautiful, that

Intersection With State Highway Before Construction

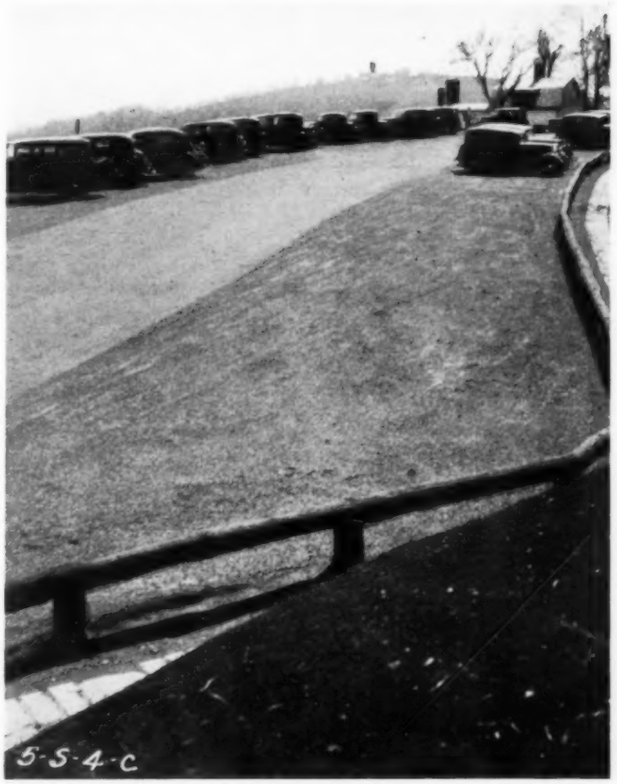
TABLE I.—COMPARATIVE STATEMENT OF RELATIVE COSTS—MONTICELLO ESTATE ROAD

Item No.	Description	Unit	Quantities: Estimated	Quantities: In Place	Quantities: Overrun	Quantities: Underrun	Unit Cost: Engrs. Est.	Unit Cost: Low Bid	Unit Cost: Force Acct.	Total Cost: Engrs. Est.	Total Cost: Low Bid	Total Cost: Force Acct.	Comparative Cost Based on Quantities Placed and Low Bid Contract Prices: Item No.	Comparative Cost Based on Quantities Placed and Low Bid Contract Prices
1.	Clearing and Grubbing	Acre	1.5	1.5	...	...	$200.00	$400.00	$202.96	$ 300.00	$ 600.00	$ 304.44	1.	$ 600.00
2.	Unclassified Excavation	Cu. Yd.	10,000	9,021	...	979	.50	.70	.52	5,000.00	7,000.00	4,718.27	2.	6,314.70
3.	Structural Excavation	Cu. Yd.	550	714	164	...	1.00	1.50	.79	550.00	825.00	567.05	3.	1,071.00
4.	Overhaul	Sta. Yd.	3,000	...	...	3,000	.01	.02	...	300.00	600.00	.....	4.	.....
5.	Cement Rubble Masonry	Cu. Yd.	190	206	16	...	12.00	18.00	14.40	2,280.00	3,420.00	2,966.19	5.	3,708.00
6.	Dry Rubble Masonry	Cu. Yd.	130	135	5	...	5.00	10.00	1.97	650.00	1,300.00	265.60	6.	1,350.00
7.	Dry Rubble Gutter	Sq. Yd.	1,767	1,628	...	139	.75	1.00	1.78	1,325.25	1,767.00	2,903.74	7.	1,628.00
8.	Brick Gutter, including base	Sq. Yd.	70	30	...	40	3.00	5.00	3.07	210.00	350.00	92.20	8.	150.00
9.	Brick Curb, including base	Lin. Ft.	300	93	...	207	.25	2.00	.72	75.00	600.00	66.85	9.	186.00
10.	Brick Walk, including base	Sq. Yd.	65	53	...	12	3.00	4.00	6.88	195.00	260.00	364.56	10.	212.00
*11.	18" Corrugated Metal Pipe	Lin. Ft.	944	171	...	773	1.00	1.50	1.18	944.00	1,416.00	202.66	11.	256.50
*12.	24" Corrugated Metal Pipe	Lin. Ft.	52	384	332	...	2.00	3.00	1.61	104.00	156.00	618.90	12.	1,152.00
*13.	30" Corrugated Metal Pipe	Lin. Ft.	108	150	42	...	3.00	4.00	2.61	324.00	432.00	391.90	13.	600.00
14.	Relaying 18" Corrugated Metal Pipe	Lin. Ft.	100	24	...	76	.50	1.00	.10	50.00	100.00	2.40	14.	24.00
15.	Relaying 24" Corrugated Metal Pipe	Lin. Ft.	52	...	...	52	.75	1.25	...	39.00	65.00	.....	15.	.....
16.	6' Tile Underdrain	Lin. Ft.	500	...	...	500	.60	2.00	...	300.00	1,000.00	.....	16.	.....
17.	Timber Guard Rail	Lin. Ft.	1,000	620	...	380	.75	1.00	.91	750.00	1,000.00	567.01	17.	620.00
18.	18" Drop Inlets	Each	30	17	...	13	30.00	30.00	31.64	900.00	900.00	537.93	18.	510.00
19.	Stripping and Storing Top Soil	Cu. Yd.	800	403	...	397	.60	.60	.21	480.00	480.00	83.17	19.	241.80
20.	Placing Top Soil	Cu. Yd.	800	403	...	397	.60	1.00	1.12	480.00	800.00	448.42	20.	403.00
21.	Removal of Existing Cement Walls	Lin. Ft.	521	529	8	...	.75	1.00	.45	390.75	521.00	236.84	21.	529.00
22.	Removal of Dry Rubble Masonry Walls	Lin. Ft.	450	696	246	...	.40	.40	.12	180.00	180.00	85.53	22.	278.40
23.	Broken Stone Tree Root Protection	Cu. Yd.	200	32	...	168	.75	4.00	1.47	150.00	800.00	47.02	23.	128.00
24.	Scarification of Existing Road	Sq. Yd.	5,700	2,662	...	3,038	.10	.10	.06	570.00	570.00	142.64	24.	266.20
25.	Stone Base Course	Sq. Yd.	10,750	11,200	450	...	.75	1.00	.61	8,062.50	10,750.00	6,805.51	25.	11,200.00
26.	Bituminous Material for Prime	Gal.	3,600	3,400	...	200	.10	.13	.13	360.00	468.00	442.00	26.	442.00
**27.	Eliminated		...	...	...	...	...	...	...	.....	.....	.....	27.	.....
28.	Stone Chips for Cover	Ton	180	13	...	167	3.00	3.00	1.80	540.00	540.00	23.31	28.	39.00
	Totals									25,509.50	36,900.00	22,884.24		31,909.60
	Engineering and Contingencies									2,550.95	***	1,374.58	Extra Work	5,715.23
													Plus 15% Extra Work	857.28
	Extra Work Performed Not Included in Original Estimate									$28,060.45	$36,900.00	$24,258.82		38,482.11
**27.	Plant Mixed Cold Lay Top	Sq. Yd.	10,355						.52			$5,398.43	Plus Engr. Cost	2,550.95
	Board Fence	Lin. Ft.	632						.09			61.00		
	Entrance Gates	Each	2						65.00			130.00		$41,033.06
	Brick Steps	1000	2,000						43.77			87.55		
	Grass Seed on Slopes	Acre	3						12.75			38.25		
	Total Extra Work Performed											$5,715.23		

*Corrugated Metal Pipe included in original estimate; Eliminated and replaced by Reinforced Concrete Pipe.

**Second application for surface treatment eliminated and replaced by Asphaltic Bituminous Concrete (Plant mixed cold lay).

***It will be noted that no provision has been made to show approximate cost of Engineering, had the work been let to contract.



Above: Parking Area Before Construction. Below: Parking Area After Completion.

they can provide comfortable relaxation and recreation and in other ways can be so worked out as to serve aesthetic requirements as distinct from requirements purely utilitarian.

Aesthetic Objective of Estate Roads.—In the development of estate roads, the usual aesthetic objective is a quiet dignity attuned to the natural surroundings, an approach so harmonious with the place to which access is provided, that all thought of the highway as a separate structure is lost in the feeling of quiet enjoyment of the settings in which it fits as an unobtrusive part.

This thought was in mind when the driveway on the Monticello Estate was designed. It was laid out to follow the general line of the old road, but at the same time curves were flattened and grades reduced and the work, as a whole, so fitted into the surroundings in which it was placed that it gives the impression of belonging just where it was put. Here lies the art of correct design in this field—a result which those who use the highway feel is natural and proper rather than artificial and forced. This result, of course, requires that fills must be largely avoided and that where they are used, they must be so masked that they do not give the impression of being artificial creations. Where cuts are required, they, too, must be so worked out as to avoid an appearance of artificiality. On side hill work, and most of this road involves side hill construction, this is not so difficult to accomplish. Slopes can be drawn out and rounded off. A few trees can be moved and the shrubbery rearranged. The irregularities in nearby ground can be smoothed. Such rearrangements need not be expensive. Indeed, in this particular case, they were not expensive. But all of these things, when it is necessary to do them, must be done in such a way that within a short time no trace will be left to indicate that they have been done at all!

Treatment of Incidental Design Features.—Another thing to be considered in designing estate roads is the treatment of incidental points in design. Where walls or fences must be moved or reconstructed, the architectural treatment of the reconstruction must harmonize with the dominant architectural note. In designing the Monticello Estate Road, this thought was carried out in all necessary reconstructions. Even the gutters on the road itself were made of brick, the better to fit into the general architectural scheme.

In this day of travel by automobile, no estate road is adequate unless in addition to providing comfortable and dignified accessibility, it also provides an adequate space for parking cars, conveniently located. For an ordinary estate, this space can, as a rule, be conveniently provided by widening the road at or near any point where cars are likely to congregate. For a point of national interest such as Monticello, a simple treatment of this sort is not adequate. In its stead a parking area of some size is required. This was provided by enlarging and otherwise improving the area just outside the entrance to the grounds proper. To do this, it was necessary somewhat to modify the old entrance at this point as well as to enlarge the area available for parking by fairly heavy grading at this point.

Above: Section of Road During Construction. Below: Section of Road After Completion.

Entrance to Estate After Completion

A Successful Force Account Operation.—The work at Monticello is interesting for another reason—namely, as a successful force account operation. The original appropriation authorized a gross expenditure of $30,000. The engineer's estimate of the cost of this work was $25,509.50, plus $2,550.95 for engineering and contingencies. Bids were received on Aug. 30, 1934, and when they were opened, it was found that the bids ranged from a low of $37,459.00 to a high of $52,039.00.

The Bureau of Public Roads has consistently favored, and continues to favor, a policy of construction by contract. But here it faced two facts—first, that the low bid considerably exceeded the amount Congress had made available for this work; and second, that the engineers who had prepared the original estimates, stubbornly asserted that the work could be done within the estimated cost. In view of the need for an early completion of this road and the evident impossibility of having it constructed by contract within the funds available, it was decided to proceed by force account. Work was started on this basis on Sept. 15, 1934, a superintendent and a small crew being put to work on clearing and grubbing.

After rather careful study of this phase of the work, it was decided to sublet the grading (10,000 cu. yd.) and the work of stripping and storing top soil (800 cu. yd.). Bids were received for this work on Sept. 26, 1934, and the work was awarded to the low bidder, Hall & Mitchell, of Keswick, Virginia, at 15 ct. a cubic yard, their bid price.

Later on bids were received for furnishing 600 tons of bituminous concrete surfacing material and award made to McGuire & Ralph of Washington, D. C. The project was completed on April 22, 1935, and is now in service.

The final results secured on this project indicate that the decision to proceed by force account was a wise one. Final cost on the project as advertised was 65 per cent of the lowest bid received. It was 81 per cent of the authorized expenditure, and nearly $3,000 less than the engineer's original estimate.

Because the low cost at which the project, as advertised, was handled, had left a considerable balance available, certain desirable extra work to the amount of about $5,700 was done. This with engineering expenses, brought the final cost to something over 99 per cent of the amount available for the work and to some 81 per cent of the low bid. The details as to the engineer's estimate for, the low bid on, and the actual cost of this work are shown in Table I. These facts are not presented as an argument for force account work and should not be so interpreted. Rather, they are presented as an indication that occasionally contractors overestimate the difficulty of specific jobs and that, when they do, a well developed engineering organization, under proper discipline and under efficient control should be able, as in this case, to step in and demonstrate the validity of its estimates by actual performance within the cost limits they establish.

As to the details of construction methods, nothing much need be said. They were perfectly normal for work of the kind the estimate indicates and were handled in full accord with the controlling specifications which did not differ from specifications usually in effect for such work except when and as special requirements were necessary in order to insure an artistic treatment of some phase of the work.

Culvert Headwall

Section of Timber Guard Rail

Drop Inlet Completed

Seismic Method of Shallow Subsurface Exploration

THE seismic method of subsurface exploration has been used extensively for locating salt domes and other oil-bearing structures and in certain types of mining operations. This method had not been applied to shallow determinations until recently, when tests were made by the U. S. Bureau of Public Roads. These extended over a period of several months on known formations around Washington and indicated that, for determining the presence and location of consolidated rock, the seismic method is more reliable and accurate and in other ways superior to the resistivity method.

The seismic method of exploration takes advantage of the wide difference in the acoustic properties of plastic and granular matter on the one hand and rigid or consolidated matter on the other. Nonrigid matter such as sand, clay or gravel transmits sound waves at velocities of 1,000 to 6,000 ft. per second, while rigid materials like rock or crystalline matter transmit such wave disturbances at 16,000 to 20,000 ft. per second. We thus have a means of measuring directly that property of subsurface materials with which the engineer is concerned, namely, rigidity, while the resistivity method is used in attempts to measure this property indirectly or through its somewhat questionable relation to electrical resistivity. The seismic method is, therefore, more definite in the identification of solid rock than is the resistivity method but cannot readily be used to distinguish between clay and coarse sand or gravel, as can often be done with the resistivity method.

Seismic Apparatus Simplified for Shallow Work.—In view of the success with which the seismic method of exploration has been applied to oil prospecting, and in view of the fact that it is distinctly the most favored of all geophysical methods, it is somewhat suprising that it has not heretofore been adapted to relatively shallow determinations. Perhaps the reason for this is to be found in the array of apparatus and equipment ordinarily required and the cost of such operations as commonly carried out. The Division of Tests of the Bureau of Public Roads believed that a large part of the equipment required for deep prospecting could be eliminated or greatly simplified in an apparatus designed primarily for relatively shallow work, and that a so-called "vest-pocket" model of the more extensive apparatus could be constructed to meet these requirements. The most important difference between deep and shallow exploration is the relatively short shooting distances involved in the latter and this has made the simplification of apparatus possible. Telephonic communication between shot point and recorder is not needed and most of the cumbersome wire and reels are eliminated. Only small charges of explosives are required and these can be placed in a 1¼-in. soil-auger hole, thus eliminating the heavy drilling equipment required in deep work. The short shooting distances also permit the use of less sensitive instruments and amplifying equipment is not needed.

With these modifications in mind apparatus was assembled, consisting of a 3-element oscillograph with camera for photographic recording, 3 microphonic detectors or pick-ups and two 6½-in. spools of wire. Accessories consist of 2 camp stools, one 4-ft. soil auger, 4 no. 6 dry cells or a small storage battery, 1 developing tank with developing and fixing solutions, and 1 changing bag. The whole outfit, together with a crew of 3 men, can be carried in a small car and can be set up for operation in about 10 minutes. This equipment and how it was operated and the results obtained from it are described by E. R. Shepard, Research Engineer of the Bureau in June Public Roads.

The laborious calculations in the application of involved formulas often necessary in deeper determinations can be dispensed with where shallow structures are concerned, and in their place a simple equation substituted, requiring only a mental calculation or, at most, a slide-rule operation for its solution.

The Apparatus.—The essential units of the apparatus used are shown in Fig. 1. The detectors are of the microphonic type and consist of four microphone buttons connected in parallel and mounted with axes vertical. The mica diaphragms have been replaced with dental rubber diaphragms that carry polished carbon disks. These lower elements of the buttons are carried on a ring that is integral with a floating inertia weight in which gravity is balanced by a helical spring about 3 in. long mounted in the vertical neck of the detector. Lateral alinement is maintained by a thin steel spider diaphragm and stops limit the vertical movement of the inertia weight to less than 1/16 in. The upper element of the button consists of a conical carbon chamber with polished surfaces and containing carbon granules.

The resistance of this assembly changes enormously with the slightest disturbance, thus making it a detector of exceptionally high sensitivity. While it is subject to some of the inherent defects of the carbon microphone, it is perhaps the only type of detector that can be used in the field successfully without amplifiers. This feature makes it particularly suited to shallow exploration work where simplicity and portability are of first importance.

When in operation each detector carries a current of from 5 to 10 milliamperes supplied from dry cells or a small storage battery. This current passes through the primary coil of a transformer; the secondary coil is in series with a galvanometer of the oscillograph type. The galvanometer, therefore, responds only to a change of current in the detector.

The galvanometers are of the coil type having a direct-current sensitivity of about 4 milliamperes per inch of deflection at 10 in. and an undamped frequency of 1,200 cycles per second. The elements, carrying small reflecting mirrors, are damped in oil. An optical system directs light from a 2.5 ampere, 4-volt, straight-filament lamp to the galvanometer mirror, from where it is reflected and brought to a point focus in the plane of a moving photographic film.

Time lines on the film are obtained from "peep slits" carried on the tines of an electrically driven tuning fork that vibrates at a normal frequency of 100 cycles per second. The slits are ½ in. long and 0.01 in. wide and coincide in the neutral position of the fork and therefore give two lines for each complete cycle of the fork. The timing requires an independent lamp and optical system with the exception of the cylindrical lens (mounted immediately in front of the film) which is common to both light systems.

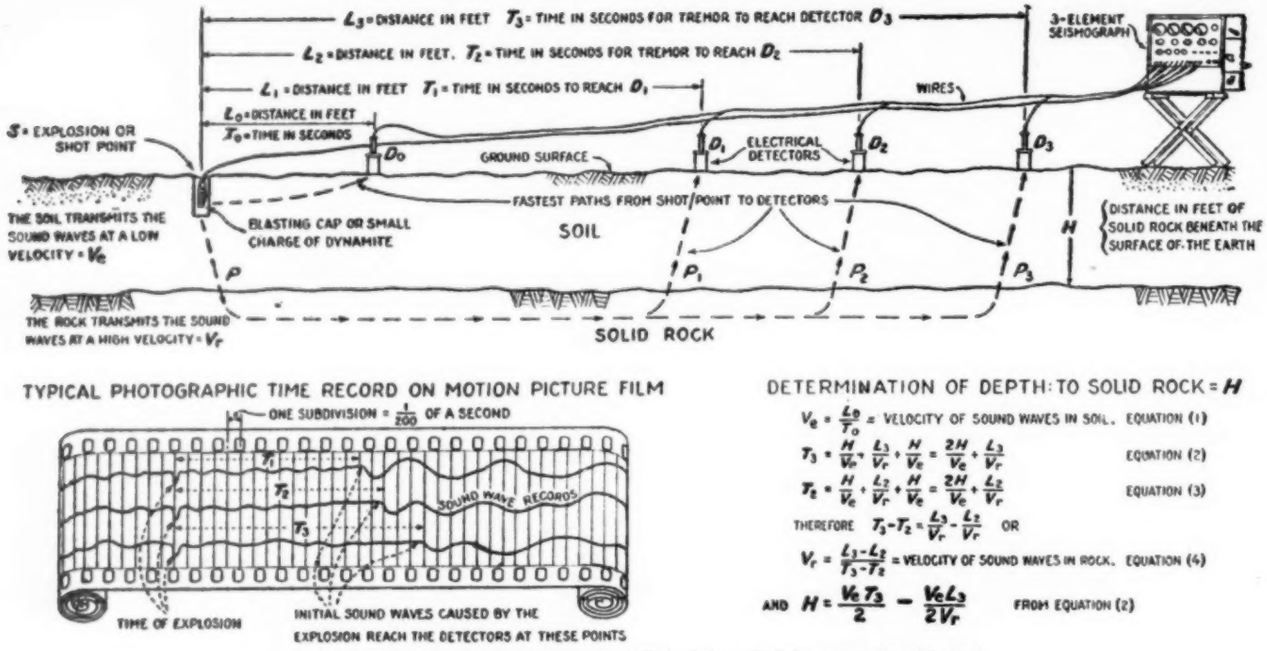


Fig. 1—Sketch Showing Fundamental Principles of Seismographic Method

The camera used for moving the film is an adaptation of a Sept camera, an obsolete, amateur motion-picture camera of French manufacture, which carries a 35-millimeter film. A direct drive was substituted for the intermittent motion and other necessary changes were made. A spring motor drives the film at approximately 2 ft. per second. The film attains its maximum speed almost instantly upon starting the motor and permits a record to be obtained with a film consumption of about 18 in. A numbering lamp and two dials of perforated numbers were installed in the camera and make it possible to number films photographically from 0 to 99. This feature enables definite identification of records after development. A film cutter operated by a trigger is provided to cut the film whenever desired. As the developing tank accommodates 6 ft. of film it is customary to cut the film after every third or fourth shot.

Standard, supersensitive, motion-picture film is used as it was found that less-sensitive film did not give sufficiently dense traces. Records are developed in a dark room when convenient, or in a Leitz developing tank in the field. A changing bag is needed in transferring the exposed film from the camera to the developing tank.

This equipment, with the exception of the detectors, was built in the shop of the bureau, after purchasing such items as galvanometers, tuning fork, lenses, and minor electrical supplies.

Determinations Based on Elementary Principles.—Two methods of seismic exploration that are in common use are known respectively as reflection shooting and refraction shooting. These terms have the same significance in geophysics that they do in optics, as the mathematical theory of transmission of sound-waves through solids and liquids is based largely on the well-known laws of optics. In reflection shooting the interpretations are based on waves that are reflected directly from different strata under investigation, while in refraction shooting it is the refracted waves that are studied. As reflection shooting is not well adapted to shallow explorations, no further space will be given to description of that technique.

The principles involved in refraction shooting are illustrated in Figs. 1 and 2. A blasting cap or small charge of dynamite is exploded at or under the surface of the ground at some point, S, which becomes the center of a wave disturbance that moves outward on a spherical or near-spherical front in all directions. Detectors D_1, D_2, and D_3, placed on a line passing through S, pick up this disturbance successively and carry the impulses to three galvanometers that record them as light traces on a moving photographic film.

A small wire is wound around the blasting cap and arranged so that when it is broken by the explosion an initial kick or impulse is given to the three galvanometers and the time of the explosion is thereby indicated on all three traces. As the wave front moves outward from S, its time of arrival at each of the three detectors is indicated on the moving film by disturbances in the traces as shown in Figs. 4, 5 and 6. By counting the number of time units between the initial kick and the arrival of the wave at each detector, it is possible to calculate the average velocity of wave propogation from shot point to each detector. From data of this kind it is usually possible to determine with a fair degree of accuracy the depth to the first strata of rigid or consolidated rock and to obtain other information of value regarding the character of the subsurface material.

Referring to Fig. 2, the path of the first wave to reach any detector will depend upon the ratio of the shooting distance, L, to the depth to rock, H, and also upon the relative velocities of wave propagation in the two media. If the shooting distance is relatively short, such as L_1, the path of the first disturbance to reach D_1 will be directly through the soil as indicated. The velocity of the wave through the earth can then be calculated from the equation,

$$V_e = \frac{L_1}{T_1} \qquad (4)$$

As the shooting distance is increased, a point such as D_2 will be reached where the wave first to arrive will no longer be that going directly through the top soil but that taking the path of the refracted wave SPP_2D_2. Subsequent disturbances will reach detector D_2 by vari-

ous paths but as only the first arrival can be definitely identified on the film record it is necessary to base interpretations solely on so-called "first events." Likewise the first wave to reach D_3 will be by the path SPP_3D_3. By measuring the time difference $T_3 - T_2$ and the distance $L_3 - L_2$ we are able to calculate the velocity of wave propagation through the rock from the equation,

$$V_r = \frac{L_3 - L_2}{T_3 - T_2} \qquad (5)$$

This relation is obvious from the fact that the time difference $T_3 - T_2$ is taken up by the travel of the wave through the rock from P_2 to P_3, since that part of the path SPP_2 is common to both circuits.

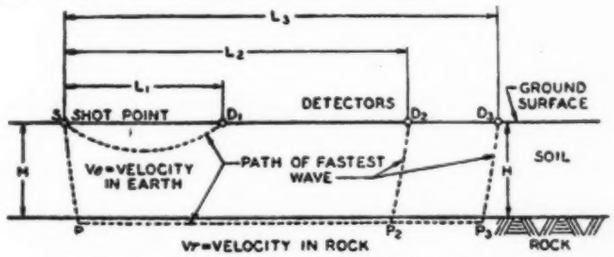


Fig. 2—Wave Propagation in Seismic Exploration

We are now able to write the equation by which H, the depth to rock, can be calculated from known quantities. This is based on the fact that T_3, the total time of travel of the wave from S to D_3, is the sum of the combined times of wave travel over the path SPP_3D_3. Although refraction of the wave at the point P is supposed to take place at the angle of total internal refraction, we may assume with negligible error under practical conditions that this angle is 90° and that the distance PP_3 is equal to L_3. With this assumption we may write,

$$T_3 = \frac{H}{V_e} + \frac{L_3}{V_r} + \frac{H}{V_e} = \frac{2H}{V_e} + \frac{L_3}{V_r} \qquad (6)$$

$$\text{or } H = \frac{V_e T_3}{2} - \frac{V_e L_3}{2V_r} \qquad (7)$$

When the distance L_3 is of such value that the direct wave through the earth reaches detector D_3 at the same time as the refracted wave, it is said to be the critical distance and we may write,

$$T_3 = \frac{L_3}{V_e} = \frac{2H}{V_e} + \frac{L_3}{V_r} \text{ or}$$

$$H = \frac{L_3}{2}\left(1 - \frac{V_e}{V_r}\right) \text{ and}$$

$$L_3 = \frac{2H}{1 - \frac{V_e}{V_r}} \qquad (8)$$

For best results, when determining depths to rock, L should not be greatly in excess of the critical distance. As a fairly close approximation we may say that for values of V_e and V_r usually found, $H = 0.45\ L$, or $L = 2.2\ H$, where L is the critical shooting distance.

Various modifications of the technique just described are sometimes necessary to determine slopes, domes, and other irregularities in underground structures. The depth to rock H, as given in Equation 7, is really the average of the depth at the shot and that at the detector. By shooting near one end of a line of detectors and then near the other end an estimate of the slope can be obtained. "Circle shooting" is another means of studying subsurface irregularities. With this method two or more detectors are placed on the arc of a circle having a radius greater than the critical distance and the shot is placed at the center. The order in which the waves reach the detectors will indicate the relative rock depths under them, the shorter time indicating the shallower rock.

Equation 5 cannot always be relied upon to give very accurate values of V_r because of the difficulty of obtaining an accurate measure of the time intervals $T_3 - T_2$ from the film record. If the detectors are placed 20 ft. apart the time interval representing a velocity of 18,000 ft. per second in the underlying rock will be only 0.0011 second, or a distance of about 0.0264 in. on a film moving at a speed of 2 ft. per second.

It is obvious that slight differences in the performance of different detectors and errors in picking the exact time of breaks on the traces will make it impossible to determine velocities in rock by the use of closely placed detectors. Fortunately, the term in Equation 7, in which V_r appears, is of minor importance, provided the shooting distance is not greatly in excess of the critical distance. For this reason an average or normal value of V_r, such as 18,000 ft. per second may be assumed without fear of carrying through an error of consequence into the final value of H. Equation 7 may be used only when the shooting distance exceeds the critical distance, and this condition can usually be determined from a measure of the time intervals between detectors, even though such intervals may not give highly accurate values of velocities in rock.

Field Tests Give Satisfactory Results.—The accuracy with which H can be determined from Equation 7 will

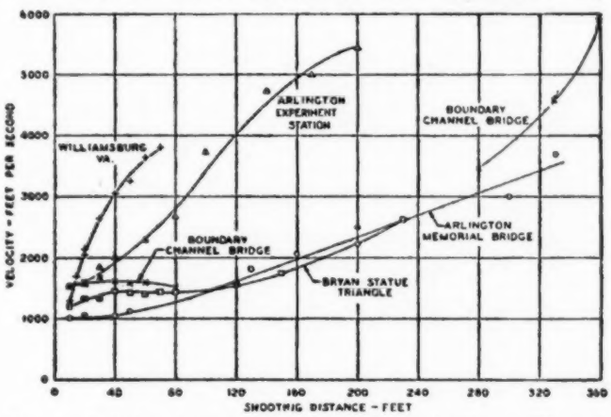
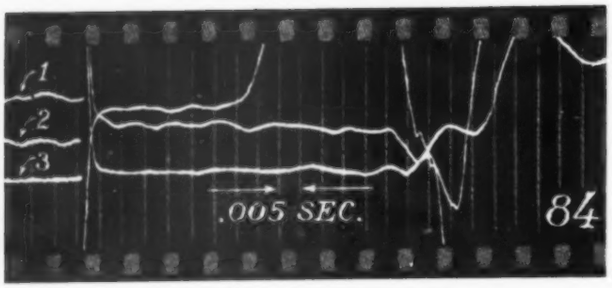


Fig. 3—Relation between Velocity of Sound Waves Through Earth as Obtained with the Electrical Seismograph

depend largely upon the value of V_e selected. In most soils the value of V_e increases with depth and the value to be substituted in the equation must therefore be intermediate between the velocity in the topsoil and that in the deeper strata. Figure 3 shows several velocity-distance curves from which value of V_e were selected in determining rock depths at the locations given. All of the curves show a distinct upward trend after the critical shooting distance is reached or, in other words, when the path of the fastest wave is through rock. At the Boundary Channel Bridge the rock is overlain with about 75 ft. of spongy muck or silt and this condition is indicated by the rather flat portion of the curves within the critical distance. The same condition exists at the Bryan statue triangle and at the Memorial Bridge, in



CALCULATION OF DEPTH TO ROCK

Shooting distances, $L_1 = 50$ feet, $L_2 = 100$ feet, $L_3 = 150$ feet. Time of wave travel from shot to detectors, $T_1 = .0355$ second, $T_2 = .071$ second, $T_3 = .074$ second.

V_e = Velocity of wave in earth $= \frac{L_1}{T_1} = \frac{50}{.0355} = 1{,}400$ feet per second.

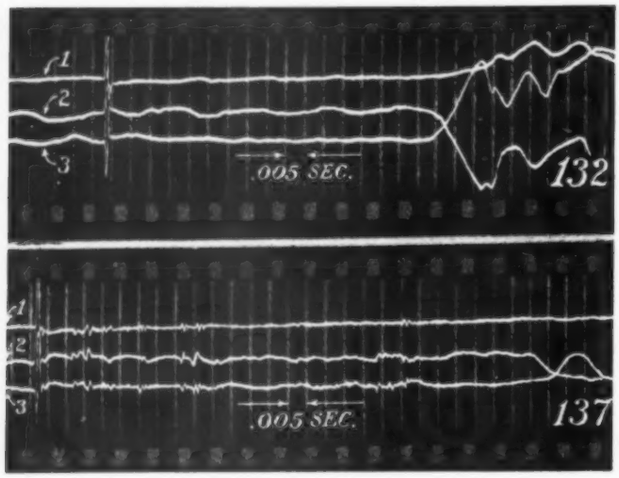
V_r = Velocity of wave in rock $= \frac{L_3 - L_2}{T_3 - T_2} = \frac{50}{.003} = 16{,}700$ feet per second.

H = Depth of rock $= \frac{V_e T}{2} - \frac{L V_e}{2 V_r} = \frac{1{,}400 \times .074}{2} - \frac{150}{2} \times \frac{1{,}400}{16{,}700} = 45.5$ feet.

Fig. 4—Seismic Record and Calculations Based on Record

both locations the critical distance being approximately 100 ft. From the flat portion of such curves closely accurate values of V_e can be selected and equally accurate values of H obtained.

Figure 4 shows a single record from which the depth of rock at the Memorial Bridge has been calculated. The 3 detectors were spaced respectively 50, 100, and 150 ft. from the shot. In this case the critical distance



CALCULATION OF DEPTH TO ROCK

From film 132, $L = 110$ feet, $T = 0.85$ second, $V_e = \frac{L}{T} = 1{,}300$ feet per second.

From film 137, $L_2 = 330$ feet, $L_3 = 360$ feet, $T_2 = .135$ second, $T_3 = 0.1385$ second.

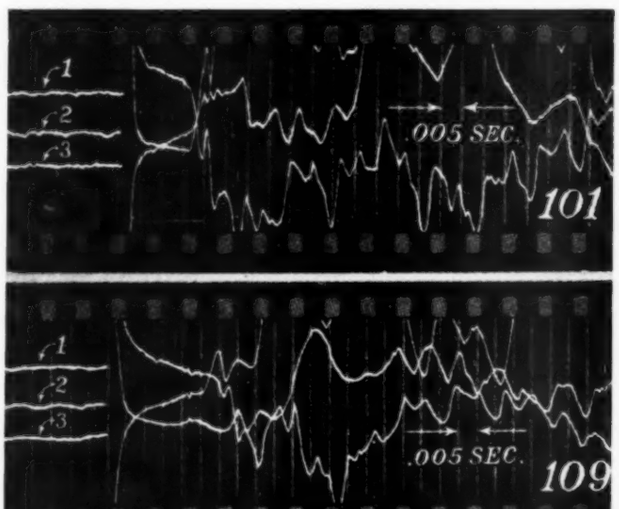
For $L = 360$ feet, depth to rock $= H = \frac{V_e T}{2} - \frac{L V_e}{2 V_r} = \frac{1{,}300}{2} \times .1385 - \frac{360 \times 1{,}300}{2 \times 16{,}700} = 90 - 14.0 = 76.0$ feet.

Fig. 5—Seismic Record and Calculations Based on Record

appears to be almost exactly 100 ft. This follows from the fact that calculations based on traces 1 and 2 result in the same velocity, thus indicating that the wave reaching P_2 could have traveled directly through the earth. However, the difference in time intervals T_3 and T_2 is such as to give a velocity of 16,700 ft. per second between P_2 and P_3, which is very close to velocity in rock. It is evident, therefore, that the time of travel to the middle detector is the same by either the direct path or the path of the refracted wave through the rock, a condition that determines the critical distance.

Figure 5 shows records from which the depth to rock at the Boundary Channel Bridge was calculated as 76 ft., a figure that checks closely with the bridge engineer's data.

Difficulty Sometimes Encountered in Making Determinations.—Frequently the velocity curve will take the form of the curve in Fig. 3 that is based on tests at the Arlington experiment station. Here the critical distance



CALCULATION OF DEPTH TO ROCK

From film 101, $L_1 = L_2 = L_3 = 30$ feet, $T = 0.0165$ second, $V_e = \frac{L}{T} = 1{,}820$ feet per second.

From film 109, $L_1 = 120$ feet, $L_2 = 150$ feet, $L_3 = 180$ feet, $T_1 = 0.0255$ second, $T_2 = 0.029$ second, $T_3 = 0.0325$ second. For $L = 150$ feet.

Depth to rock $= H = \frac{V_e T}{2} - \frac{L V_e}{2 V_r} = \frac{1{,}820}{2} \times 0.029 - 75 \times \frac{1{,}820}{16{,}700} = 17.2$ feet.

Fig. 6—Seismic Record and Calculations Based on Record

is not so evident. The method by which a value of V_e was selected that the depth to rock calculated in this location will be given in detail as a typical example of a practical problem. Figure 6 shows some of the records from which depth calculations were made and Table I is summary of all data obtained. An examination of this table shows that high velocities existed for that portion of wave travel in excess of 50 ft. Because of the very short time intervals involved and the difficulty in picking the exact breaking points on the traces and also as a result of slightly different sensitivities and characteristics in detectors, it is not always possible to obtain accurate velocities for increments in distance from which velocities in rock can be derived. It is possible, however, as in this case, to determine from the velocities

TABLE I.—RESULTS OF TESTS AT THE ARLINGTON EXPERIMENT STATION.

Record No.	Shooting distance, L	Time of wave travel, T	Overall velocity, V	Velocities for increments in distance, equation 5		Depth to rock, H, from Equation 7
	Feet	Seconds	Feet per second	Feet	Feet per second	Feet
97.....	10	0.0065	1,540	10 to 20 =	1,540	...
99.....	20	.013	1,540	20 to 30 =	2,860	...
101.....	30	.0165	1,820	30 to 40 =	2,860	...
104.....	40	.02	2,000	40 to 50 =	5,000	...
106.....	50	.022	2,270	50 to 60 =	20,000	...
107.....	60	.0225	2,670	60 to 100 =	8,900	17.2
100.....	100	.027	3,700	100 to 120 =	Infinite	19.2
109.....	120	.0255	4,700	100 to 150 =	25,000	16.7
109.....	150	.029	5,000	100 to 180 =	10,700	18.2
109.....	180	.0325	5,450	60 to 180 =	12,000	19.8
Average						18.22

if the movement is through rock and also to approximate the critical distance.

The high velocities for that portion of the travel through increments in distance at more than 50 ft. from the shot enables us to select 50 ft. tentatively as the critical distance. By averaging all of the over-all velocities for distances of 50 ft. and less, a value of 1,834 ft. per second is obtained. This is so close to the value of 1,820 ft. per second derived directly from record no. 101 for a 30-ft. distance that the latter was selected for V_e. Since the values of velocities corresponding to increments in distance shown in Table I are not sufficiently consistent to justify a selection of V_r from them, a value of 16,700 is taken as fairly representative of velocity in rock. As pointed out previously, this value enters into only a minor term in the depth equation and therefore great accuracy is not so necessary in its determination as in that of V_e. With these values of V_e and V_r the value of H was computed for all distances in excess of 50 ft. The results appear in the last column of Table I, the average of which is 18.22 ft. The actual depth to rock as determined with a soil auger is 19.8 ft.

Sometimes it is necessary to make a first approximation of the depth to rock, after which a more accurate value of V_e can be selected from the velocity curve. In any event, no great error will be made in selecting a value of V_e, which is an average of all values obtained under the critical distance.

The velocity curve obtained at Williamsburg, Va., Fig. 3, applies to a marl and shell conglomerate overlain by a few feet of clay. The velocities found are relatively high for a location where there is no rock near the surface and are the result of the highly compacted shell conglomerate which appears to have about the same acoustical properties as a deep clay or shale.

A few tests have been made at quarry sites and at other locations where solid rock is found within a few feet of the ground surface and all indicate that the depth of such overburdens can be determined quickly, definitely, and accurately by the seismic method. For such work a single no. 8 blasing cap gives ample energy, thus reducing the cost of explosives to a negligble amount.

While the work of the bureau with the seismograph has been largely experimental and limited to one locality, the results to date have been so promising that they leave little doubt as to the ultimate value of this tool in the study of subsurface formations.

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SODIUM VACUUM LIGHTS TO ILLUMINATE BAY BRIDGE, CALIFORNIA.—Sodium vapor lighting has been selected to illuminate the San Franciso-Oakland Bay bridge, and bids for electrification of the bridge were received June 26. Approximately 1,000 light standards, 26 ft. above the roadway, will be located 150 ft. apart on both decks of the bridge.

PWA and WPA Projects Defined

The types of applications to be considered by the Public Works Administration and the Works Progress Administration were defined as follows in a statement issued on July 3:

PART I

In order to assure the expeditious and orderly handling of the great number of applications of States, territories, possessions, including subdivisions and agencies thereof, municipalities, the District of Columbia, and public bodies, now being submitted under the Emergency Relief Appropriation act of 1935, and in order to further the development of a balanced program of sound projects which will take a maximum number of workers off the relief rolls, it is desirable to define what types of projects shall be within the jurisdiction of the Federal Emergency Administration of Public Works and what types of projects shal be within the jurisdiction of the Works Progress Administration.

PART II

Applications shall be submitted to the Federal Emergency Administration of Public Works for:

1. Works projects: Construction projects (other than repair and maintenance projects, and other projects directed in this statement to be submitted to the Works Progress Administration) where the aggregate cost upon completion is estimated to be more than $25,000.

Examples of such projects are: Airport buildings, armories, almshouses, auditoriums, bulkheads, canals, docks, dormitories, school and university buildings, electric heat, light and power plants and distribution systems, gas plants and distribution systems, jetties, piers, wharves, highways, bridges, tunnels, subways, viaducts, hospitals, dispensaries, sanitariums, fire and police stations, jails, libraries, sanitary sewer systems, drainage improvements, garage and rubbish disposal plants, public buildings, sewage disposal plants, storm sewer systems, terminals, water supply and distribution systems, filtration plants, and other similar projects.

2. Slum clearance and low cost housing projects:

Projects of a type heretofore carried on by the Housing Division of the Federal Emergency Administration of Public Works.

PART III

Applications shall be submitted to the Works Progress Administration for:

(1) Nonconstruction projects: Projects of a type designed to assure maximum employment principally to professional, clerical and white collar classes.

(2) Small works projects: Projects of any type where the aggregate cost upon completion is estimated to be $25,000 or less.

(3) Other works projects: All other projects, regardless of cost, except those referred to in Part II above. Examples of such projects are: Recreational facilities, parks, playgrounds, small dams, ditches, street repairs, demolition, malaria control, pest extermination, airports, sidewalks, gutters and curbs, levee work, landscaping, grading, farm-to-market roads, reservoirs, swimming pools and similar projects.

PART IV

Application rejected by the Federal Emergency Administration of Public Works shall be submitted immediately to the Works Progress Administration.

PART V

Applications for loans shall be submitted to the Federal Emergency Administration of Public Works.

PART VI

This statement shall not govern applications involving projects falling within the jurisdiction of any other Federal agency.

Scenes on the

WIDENING AND STRAIGHTENING OF LINCOLN HIGHWAY UNITED STATES ROUTE 30

Between Columbia City and Warsaw, Indiana

At a Creek Crossing near Columbia City. Northwest Crane Clearing and Excavating for New Bridge.

Bringing up Dirt from the Side. Three Baker-Maney Scrapers Pulled by a Caterpillar Sixty.

Another New Bridge Coming. Pile Driving in Cofferdam for West Abutment. Bracing of Cofferdam for East Abutment Visible Lower Left. Barnes Pump with LeRoy Engine Operating at Right.

Excavating and Setting Forms for Abutments for New Bridge over Deeds Creek. Osgood Crane in Background.

TRAFFIC on Route 30—otherwise the Lincoln Highway—has grown rapidly during the few years since its opening as an all-paved road between Chicago, Fort Wayne, and other points to the East. Now a stretch of about seventeen miles on the important section between Columbia City and Warsaw, Indiana, is being widened to 52 feet and straightened at a contract cost of $150,101. This is for grading, drainage, and structures only: widening of the pavement to 30 feet will come later, an 11 foot shoulder on each side making up the balance of the 52 foot roadway.

The pictures on this page and the preceding show some of the current operations. They were taken on June 17th—a day of numerous heavy showers which prevented photography on several of the most interesting parts of the work.

The principal contract quantities are as follows:

Excavation—Common	241,387	cu. yd.
Excavation—Peat	14,599	cu. yd.
Excavation—Special Borrow	11,983	cu. yd.
Overhaul—1 balance	12,684	cu. yd.
Overhaul—2 balances	2,188	cu. yd.
Overhaul—3 balances	1,520	cu. yd.
Finishing Shoulders and Ditches	91,116	lin. ft.
Concrete for Structures—Class "D"	731	cu. yd.
Reinforcing Steel	64,162	lb.
Special Concrete for Structures—Class "D"	599.4	cu. yd.
Pavement Removal	5,110	sq. yd.
Sodding	100,830	sq. yd.
Pipe—6 to 24 in. (chiefly 12 and 15 in.)	10,476	lin. ft.

The work is being carried out by the State Highway Commission of Indiana, as N. R. H. Project No. 66. It is let in three contracts respectively to General Dredging Co., Gast Construction Co., and Tri-Lake Construction Co. November 1 is completion date.

For a Better Foundation Alongside the Old Pavement. Lima Crane Excavating Soft, Peaty Earth and Wet Clay Ten Feet Deep. Caterpillar and Bulldozer Backfilling with Sound Material Dumped by Trucks from Roadside at Right.

Keeping Forms and Foundations Clear of Water at Deeds Creek. A Humphrey Pump at Work under Old Bridge.

Widening the Cut with Koehring Shovel and International Trucks.

A Busy Spot. P. & H. Crane Loading Indiana and International Trucks. In Background, the Lima Crane Which is Shown Closeup at Upper Right.

STATE MAINTENANCE OF COUNTY ROADS

By HENRY G. SHIRLEY
Chairman, Virginia Highway Commission

TAXES on real estate, especially farm lands, advanced rapidly from 1914 to 1928 when quite a demand was voiced from all sections that some relief be given from these taxes. Looking around for some source to which a part of this tax could be transferred, the eyes of the legislators quickly fell on the gas tax. The ease with which it had been extracted from the motorist made it an attractive source.

The theory was advanced that the users of roads should maintain and construct them, and this theory has been written into law in several States.

North Carolina, in 1929, stepped out by taking over the entire county system, and in 1932 Virginia followed North Carolina's lead.

An insistent demand was made on the members of the Virginia Legislature to give some relief to the farmer and real estate holder by reducing their taxes. This took the form in an attempt to divert the gas tax income to schools and other purposes. There was, however, quite a feeling in the State that taxes collected from the motor vehicles should be used for roads and nothing else. Those thinking along this line suggested that the State take over the entire mileage maintained by the counties, as a secondary system, and relieve the counties of the road tax levied on real estate. This in some instances amounted to 50 per cent of the total taxes paid, and it averaged 20 cents on the $100 throughout the State.

Maintenance of Routes Through Cities.—As soon as this suggestion was made there was hooked to it the proposal that the State should also contribute towards the maintenance of the main trunk highways passing through the cities, and this was provided for by appropriating $1,500 a mile for the maintenance of these routes annually, and $500 additional per mile for the total trunk highway mileage within the cities to be applied as a construction fund on projects approved by the State Highway Commissioner. It provided that the main State routes through the cities be kept in condition equal to the State roads adjacent; and, if this was done and there were any funds left over it could be used on routes other than those in the State highway system if approved by the State Highway Commissioner.

This plan immediately met with universal approval. The cities saw the possibility of lowering taxes as well as the counties, and no possible objection raised by the State Highway Commission, that taking over and assuming the full cost of operating the secondary system would greatly curtail the funds then being used on the primary system and delaying its final completion had any effect.

The corporations owning real estate, such as the railroads and public utility companies, were benefited greatly, due to the taxes on all their real estate being reduced, just as it benefited the private individual, and they were thoroughly in favor of the bill.

State Purchases County Equipment.—The act was passed near the end of March and the State Highway Commission was directed under its terms to make an inventory of all the machinery in the 100 counties of the State and arrive at a fair value, and to reach an agreement with the Boards of Supervisors of each county for its purchase. It provided that the State should pay a fair price for this equipment, or if the Boards of Supervisors so selected they could keep their own equipment or donate it to the State. Practically all the counties, with the exception of a few, sold their equipment to the State, the total amounting to approximately $600,000.

In taking over this equipment the question came up as to what would be a fair value. Much of it was obsolete yet capable of doing a certain amount of work, but it would have been much cheaper for the State to have junked the entire lot and bought new. However, some of it had not been paid for by the counties, and had an unused life of a certain value. It was appraised by the department and bought on this basis.

The law required that all the country roads that were maintained by the Boards of Supervisors outside of incorporated towns and cities be taken over by the State Highway Department. Immediately upon the passage of the act the Boards of Supervisors of the various districts, pointing out each road. In making the survey of these roads, a sketch map was prepared of the road, showing the streams, number of houses in sight, width of road, rural free delivery routes, school bus routes, the condition of the road; type of surfacing and other pertinent data that would give a true picture of the road the day it was taken over.

This was done to get an accurate measurement of each road, the type of surfacing and condition of the bridges, and a general picture as to the task that had to be performed.

A study was also made of the amount of funds that had been expended by the counties for the three preceding years.

Maps were made of each county and the roads clearly indicated and given a number.

Engineering Organization.—The State highway organization was expanded by the addition of a number of resident engineers who were placed in charge of from one to two counties. There was no expansion in the department above the resident engineer, and a few extra clerks.

The district engineers immediately were placed in charge of the county system along with the primary system and organized their districts by the addition of resident engineers into a compact unit.

The law provided that a county could vote on whether it wished to stay in the secondary system or outside and do their own work. Of the 100 counties, 96 stayed in or voted in, and 1 additional county has come in during the last 18 months, leaving only 3 counties of the 100 operating outside of this plan.

The roads were divided into patrol sections, a patrolman and helper being put on each section with proper equipment. These sections varied anywhere from 10 to

150 miles, depending on the character of surfacing, amount of traffic, and the importance of the road.

The law provided that two general public meetings be held yearly in cooperation with the Boards of Supervisors; one in the fall. The public are invited to come and express their views as to road conditions; and the other in the spring of the year, when they could come in and appear before the board, asking for certain roads to be constructed. The resident engineer sits with the Board of Supervisors, and after the public hearings makes up a budget which is submitted to the State Highway Commissioner for approval. No budget can become operative except on approval of the State Highway Commissioner.

38,000 Miles of Highway Taken Over.—There were taken over in the neighborhood of 38,000 miles in this system in Virginia. It has been in operation since July 1, 1932, and has met with approval of the general public. There has been no demand made for any county to withdraw.

It saves the real estate holders of the various counties from four to five million a year, and the cities from three-quarters to one million. This entire savings, however, was transferred from the real estate to the owners and operators of motor vehicles.

In one small county that had a budget of about $36,000, it used $27,000 of it in labor; the State, on taking over these roads, reorganized its forces, spending $9,000 in labor and $27,000 in materials. When the budget was made public showing this distribution, there was quite a complaint by the county people that there was not sufficient labor provided to keep the roads. We found the distribution to be all that was necessary and a much greater mileage was surfaced and improved than heretofore.

It is only natural that men trained in the construction and maintenance of roads, with wide experience, should be more capable of maintaining a system in a more effective way than those not so trained and from time to time are changed, due to the political set-up of county governments.

There were a number of counties that had county managers and engineers, and the work in these counties had been handled efficiently, and in most instances these engineers were taken into the State organization.

20-Year Plan for Secondary Roads.—The question of what is the best thing to do and how it should be done, with the secondary roads of the country, is an exceedingly large one. There is a great deal being said in legislative halls and the national Congress concerning the farm-to-market road. This is not a very distinct classification, as the most important feeder and market roads we have in the State are the trunk highways, but in the general meaning of the term it is the road leading back into the agricultural districts over which the farmer has to haul his produce to market and children to school or church.

There is an insistent demand that these roads be put in condition, that every mile be made usable every day in the year. This is a financial impossibility if the entire amount is to be saddled on the motorist. A close study has been made of the secondary system in Virginia, and we have worked out a 20-year plan in which we show the total mileage of each county; the mileage that should be of higher types, including concrete down to oiled gravel and sand clay; medium types of sand clay, gravel and other surface material but not oiled; and the lower type being ordinary earth roads.

In some counties the low-type or earth roads will constitute 50 per cent of the total mileage, whereas in others it will run down to as low as 10 per cent, depending on the location of the county, whether adjacent to an industrial center or in the mountainous section of the State.

We have seen what North Carolina and Virginia have done; Pennsylvania has also taken over quite a large mileage; West Virginia over all roads; Maryland has done practically the same thing; and many States are increasing their State highway mileage, which has about the same effect.

It is my opinion the proper agency to administer all the roads of the State is the State Highway Department. The counties vary so, running from a county with a very small area, population and wealth to a large county with much mileage and taxable values, making it almost impossible to write a uniform law that will cover all conditions. Roads are no longer local except in the most isolated places; the problem broadens out to one beyond the county line and has become a larger unit.

If a State was not operating a highway department and had not an efficient organization set up in every section, then it is my judgment the consolidation of counties into larger units, and employing a competent county manager, or engineer, would be just as efficient as placing them under the highway department. But this seems to be an almost impossible task, and as every State has a well-organized highway department, the speaker is of the opinion that department is the proper agency to take over and maintain all the roads, bridges, and ferries in the State. This should not be done, however, at the total expense of the motorist, but there should be a distribution of the cost in proportion to the benefits derived from improved roads, and those industries or business places that are depending solely on the traffic passing over the highways should contribute something to their cost of construction and maintenance.

The most dangerous feature of this program is that by taking over the secondary roads diversion of funds that should be expended on the trunk system will be made to the secondary roads and the completion of the trunk system greatly delayed. That has been the effect in my State. It is hoped, however, that the public will soon appreciate the value of completing the trunk-line system first and then supply additional funds to improve the secondary roads in proportion to their importance.

It is the duty of the highway departments to see that the secondary roads in their respective States are properly looked after and advise the public as to what funds will be necessary for their construction and maintenance.

The funds available for the maintenance and construction of the secondary system in my State at the present are only about half of what they should be to carry out an orderly program over a 20-year improvement plan, but we have high hopes this will be remedied.

The question of feeder or secondary roads is before us, the public demanding that these roads be taken over and put in condition they can be traveled practically every day in the year, and this goes down to a road of very minor importance. The highway departments must realize it will be their duty to undertake this work or it will be placed in some other hands not so well qualified by experience and training as are the highway departments of the various States.

The foregoing is an abstract of a paper presented at the annual meeting of the Highway Officials of the North Atlantic States.

Tourist Traffic in Florida

A SURVEY of traffic on the state highways of Florida, conducted by the Florida State Road Department at the U. S. Bureau of Public Roads from September, 1933, to September, 1934, furnishes some interesting information on the extent and economic importance of the tourist traffic in that state. Nearly a quarter of the tourist traffic, excluding the traffic of tourists who spend less than 1 day in Florida, comes from that portion of the United States east of the Mississippi and north of the Potomac and Ohio Rivers. The origin of tourist traffic is shown in figure 3 in which the volume of tourist traffic originating in the areas indicated is proportional to the area of the circle shown in each area. The average travel of this group of tourists to and from their homes is in excess of 2,000 miles. More than one-half of all tourists in Florida are from Georgia and Alabama, again excluding those who spend less than 1 day within the state. More than 10 per cent come from the states of Michigan, Wisconsin, Illinois, Indiana, and Ohio. The remaining tourists, approximately 20 per cent, have origins scattered throughout the remainder of the country. Extracts from the report on the Florida traffic survey are given in the June issue of Public Roads by L. E. Peabody, Senior Highway Economist, Division of Highway Transport of the Bureau, from which the notes in this article are taken.

Expenditures by Tourists.—Data with regard to the expenditures of tourists were obtained by a special investigator. Tourists were questioned as to the daily expenditure per party at times and places where they could be approached conveniently and with ample time for the investigator to satisfy himself with regard to the accuracy of the replies. The information was voluntarily given and was subject to critical questioning at the time by the investigator. Expenditures were tabulated under the general heads of "car expenses" and "other expenses." Separated under "car expenses" were the costs of gasoline, oil, garaging, and repairs incurred only during the visit. Overhead items, such as depreciation and insurance, that were not likely to be a direct expenditure in Florida, were not considered. Under "other expenses" were tabulated the items of food, lodging, and miscellaneous expenditures.

From the data obtained in this manner it was possible to compute the average party expenditures per day according to type of accommodation as presented in Table I. With the exceptions noted, these are the averages of expense items as given by a large number of separate parties, and considerable effort was made both in collecting the data and in the analysis to eliminate error and exaggeration. The replies by persons staying with friends and relatives and those using a combination of accommodations were so few in number as to throw doubt upon the correctness of average expenditures based upon them. Therefore, the expenditures tabulated for these groups were obtained by averaging appropriate items in other groups that were considered similar in characteristics. Expenditures by those staying one day were estimated in like manner as no replies were received from persons in this class.

The daily lodging cost to parties staying at their own homes, as shown in Table I, is the estimated daily rental value of such homes. The figure, $3.75, is based upon an average value of $6,000 per home as given by the

TABLE I.—ITEMIZED EXPENDITURES PER PARTY PER DAY ACCORDING TO TYPE OF ACCOMMODATION

Item	Hotels	Rented cottages or apartments	Tourist homes	Camps	Own home	Friends and relatives	Combination	Less than 1 day
Persons per party	2.28	2.95	2.83	3.28	2.84	3.09	2.87	2.60
Average daily mileage per car	24	22	19	22	22	...	...	...
Cost of car operation per day:								
Gasoline	$0.36	$0.32	$0.26	$0.32	$0.36	...	...	...
Oil	.04	.03	.03	.03	.04	...	...	...
Garaging	.23	.02	.02	...	...	...	...	...
Repairs	.01	.02	.01	.01	.02	...	...	...
Total	.64	.40	.32	.36	.42	[1]$0.54	[1]$0.54	[1]$0.54
Other expenditures per party per day:								
Lodging	3.66	1.39	1.12	.35	3.75	...	...	...
Food	3.18	1.90	2.46	1.22	2.39	[2]2.15	...	[2]2.23
Miscellaneous	1.33	.97	.56	.70	1.61	[1]1.03	...	[1]1.03
Total	8.17	4.25	4.14	2.27	7.75	3.18	5.32	3.26
Total expenditures per party per day	8.81	4.65	4.46	2.63	8.17	3.72	5.86	3.80

[1]Average of other types.
[2]Average of food costs for those using "rented apartments" and "own home."

TABLE II—ESTIMATE OF TOURIST EXPENDITURES BY TYPE OF ACCOMMODATION

Stopping at—	Total cars per year	Average length of stay in days	Average cost per party per day	Expenditures per year	Percentage of total expenditures
Hotels	162,590	19.5	$8.81	$27,932,000	30.87
Apartments & cottages.	22,150	87.7	4.65	9,033,000	9 98
Tourist homes	41,380	48.2	4.46	8,896,000	9.83
Camps	26,330	33.5	2.63	2,320,000	2.57
Own home	32,180	100.3	8.17	27,947,000	30.89
Friends and relatives	87,770	16.1	3.72	5,257,000	5.81
Combinations.	45,560	32.6	5.86	8,704,000	9.62
Less than 1 day	97,040	....	3.80	369,000	.43
Total	515,000	....	.....	90,458,000	100.00

TABLE III—ESTIMATE OF TOTAL YEARLY MILEAGE OF TOURIST CARS IN FLORIDA AND PAYMENTS OF GASOLINE TAX

Average miles per car per day	22
Average length of stay per car in days	29.4
Total mileage per car per visit	647
Travel in Florida to and from destination, miles	392
Total mileage per car (round figures)	1,000
Total yearly traffic	515,000
Total yearly mileage	515,000,000
Estimated miles per gallon of gasoline	14.0
Total gallons of gasoline consumed	36,786,000
Tax per gallon	$0.07
Total tax paid by tourists	$2,575,000

questionnaires and annual operating costs and carrying charges are assumed to equal 10 per cent of value, or $600 annually. This sum is charged against a season of 160 days, or $3.75 per day.

On the basis of total daily expenditures, the two most important groups are those using hotels and home owners. Parties in these groups expended $8.81 and $8.17 per day, respectively. The parties spending the least amounts were those staying with friends and relatives, $3.72 per party per day, and the campers with an average expenditure of only $2.63 per party per day.

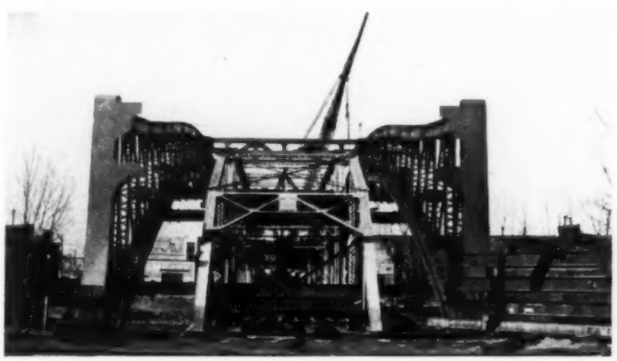
Total Yearly Expenditures in State.—The information concerning type of accommodation, volume of traffic of each type, length of stay, and daily expenditures has been combined to estimate the total yearly expenditures within the state. The estimate is presented in Table II. The total by all groups is $90,458,000.

The East Arch Erected—April 19, 1935

Design and Construction of the ASHMUN STREET BRIDGE Sault Ste. Marie, Michigan

By P. A. NORDGREN
Project Engineer

THE opening to traffic of the Ashmun Street bridge at Sault Ste. Marie, Michigan, will complete another vital step in the improvement of one of the most important highway lanes in the Upper Peninsula. This project is one of those sponsored under the National Recovery program and is being conducted under the supervision of the Michigan State Highway Department. Murray D. Van Wagoner is State Highway Commissioner. The structure will eliminate traffic congestion at a formerly dangerous bottle-neck on the main thoroughfare of the city. This street has also been adopted as the eastern terminal of State and Federal Highway US-2. The bridge will carry traffic over the Michigan Northern Power Company Canal. This waterway is part of a power development utilizing a portion of the natural water power resources created by the 21-foot difference in level between Lakes Superior and Michigan. The canal diverts water around the famous Soo Locks and St. Mary's Falls, thereby permitting production of electric power. This power is used primarily by the Union Carbide Company plant at Sault Ste. Marie.



This is not a double-exposed photograph. It is merely an end view of the old and new bridges as they appeared on April 19, 1935

Design.—Preliminary design studies on several types of bridge structures were made by the State Highway Department for this location and offered for the approval of the city of Sault Ste. Marie and the power company which holds the right-of-way at the site. It was decided that the construction of substructure units in the canal itself would be neither desirable nor feasible. This was due to the 25-ft. depth and 15-mile-per-hour velocity of the water and to the power company's objec tion against any obstruction to the flow of the water in the canal. The use of temporary false work to the canal bed was also rejected for the same reasons.

Underclearance requirements did not permit the use of deck type superstructure design. A "through" steel structure, therefore, remained as the only other practical alternative. After a study of foundation conditions, which showed that a sandstone ledge rock satisfactory for foundation purposes existed some 30 to 38 ft. below street level, a two-hinged arch was selected for this location.

The distance on the new arch, center to center of end pins, was made 240 ft., with a rise of slightly over 52 ft. from elevation of the end pins to the center line of the top chord at the middle of the span. The structure will provide a clear roadway of 42 ft. and two 6 ft. clear sidewalks. The distance, center to center, of trusses is 48 ft. The H-20 loading was selected for live-load design with proper allowance for impact. Roadway and sidewalks are hung from the arches by means of built-up structural steel hangers spaced at every other panel point of the arch, or at 26 ft. 8 in. centers.

Each pair of hangers supports a transverse plate girder, 4 ft. 6½ inches back to back of angles, which in turn carries a series of 24-in. rolled floor stringers at 4 ft. 9½ in. centers. Sway-bracing is of conventional K-type. Deck slab is of monolithic concrete varying in thickness from 1 ft. ⅝ in. at the center-line to 8¾ in. at the curbs. The slab is reinforced with double-layer, half-inch round reinforcing bars with the bars spaced

North Half of Arch Partly Erected—April 18, 1935

at 4-in, centers transversely. Sidewalks are 5½ in. thick, with the reinforced concrete resting on two 16-in. I-beam stringers. The stringers rest on brackets cantilevered out from the ends of the floor girders. Provision for expansion of the floor has been made at approximately the third points of the span where a 1½ in. thick expansion joint is provided. The ends of the floor stringers are supported on brackets at those points instead of riveted to the floor girder.

Construction.—The existing structure consisted of a "through" truss on a gravity concrete abutment. Trusses were some 23 ft. 6 inches, center to center. Because the contractors selected this structure as falsework for the steel erection, it was necessary to preserve the old abutments almost intact during the casting of the cell concrete. The design and location of the new bridge lent themselves very well to these requirements. The clear distance between the cells was sufficient to permit them to be constructed with the old abutments still in place. The north abutment tie-wall was the only major pour which had to be delayed until the old abutment was removed.

It might be well to state now some of the problems confronting the contractor upon arrival at the site. The Michigan Northern Power Company railroad track lay in an east-west direction across the south approach to the bridge and across the location for the new south abutment. This necessitated moving the track, between trains, south to clear operations. It was possible, due to the proximity of a warehouse building, to move the track to a line just south of the south cofferdam wall. It was therefore necessary to support the track on wood piling. A 24-in. sewer line also interfered with the south abutment construction and this was replaced with a run-around sewer, a portion of which was built in quicksand. It was also necessary to by-pass a high-tension power line running along the south bank of the canal to clear the wires from derrick operations.

Abutment Construction.—The south abutment was constructed within the confines of one rectangular cofferdam some 30 ft. by 70 ft. in plan. Sheeting consisted of arch-web, steel sheet-piling with double 10 in. by 10 in. timber wales and 12-in. steel I-beam struts. Excavation was carried through sand, gravel and boulders into sandstone ledge. A portion of the sheeting, encountering boulders, had to be driven as excavation progressed. This brought slow and laborious progress, particularly due to the difficulties of keeping the cofferdam free of water. For this purpose one 8-in. and one 4-in. electric centrifugal pump were used. Cofferdam work and excavation for this unit occupied three months' time.

Concrete formwork was of conventional type. The exception was a patented ¼ in. hard-board (Masonite Presdwood) used on surfaces which were to be exposed in the finished work. It was necessary to build and hold the forms for the pedestal base with exceptional accuracy to fulfill the requirements of proper fit for the bridge superstructure. A 27E concrete mixer was employed on all concrete work with a six-sack batch being used.

Work on the north abutment was started in November, 1934, and both cell units were completed during the winter months. Major difficulties on this construction were caused by water-bearing quicksand as most of the excavation and the proximity of two garage buildings. One of them, a 3-story masonry building, was on the east side of the street with the front building line within 5 ft. of the edge of the cofferdam. On the west was a 1-story brick building within 6 ft. of the cofferdam line. Under these conditions progress on the cofferdam work and excavation was necessarily slow, with every precaution taken to prevent earth displacement or undue vibration. It was necessary to excavate some 115 cu. ft. of rock before a satisfactory ledge for foundation purposes was encountered. After this was accomplished the cofferdams were housed in and heated by means of steam pipe radiators during concreting operations. This unit was completed ready for steel erection on April 10, 1935.

In connection with the substructure concrete work it should be noted that internal vibration of concrete was employed to good advantage with an electric, spade-type vibrator. Local Lake Superior concrete aggregates were also used throughout and proved extremely satisfactory in every respect.

Construction of Superstructure.—Several methods of supporting the arches during erection were considered. As previously stated, supports from the canal bed could not be used. The plan of cantilevering the arches from tie-backs was abandoned because of the difficulties of constructing safe anchorages. After a careful investigation of the super-imposed loads, wind loads, existing abutments, and the condition of the existing structure, it was decided to support the new superstructure on the existing trusses until the half-arches could be keyed together at the center-pins. The arches were supported on needle-beams normal to the bridge at points as near as possible to and on the abutment side of the bottom-chord field splices. These needle-beams were in turn supported on horizontal beams bolted to and in the plane of the existing trusses.

It was necessary to design needle-beams about 53 ft. long to be cantilevered about 12 ft. at each end. These needle-beams were constructed from the new stringers. Three stringers were laid side by side with a space of 1¼ in. between their flanges. At their end connection angles three more stringers were connected to them with ½ in. plate between abutting ends. This made a beam of the required length. Three more stringers were then

South Half of Arches Erected—April 4, 1935

placed on the original three in such a manner that their centers coincided with the abutting ends of those laid on the bottom. These were then clamped together at the center, at the points of support, and at the outside ends, the clamps also acting as spacers. This resulted in a beam 48 in. deep for the 26 ft. 8 in. in the middle, 24 in. deep at the two ends, and about 30 in. wide throughout.

Each needle-beam weighed nine tons. Each half arch was supported in this manner at four points, making the total weight of the needle-beams 72 tons exclusive of their supports. The supports were constructed of double channels, laced, and bolted to the vertical members of the existing truss at previously computed heights. Temporary brackets were bolted to the lower side of the bottom chord to provide a horizontal bearing surface. These brackets rested on hardwood wedges and blocking, which in turn rested on the needle-beams.

The total load superimposed on the old trusses was about 200 tons, which was fairly evenly divided among the eight supports. In determining the proper elevations of the supporting points the correct elevation was first computed. Proper allowance was then made for the load deflections of the truss, needle-beams, and supports. To this was added an amount necessary to carry the middle pinholes 2 in. higher than their elevation with the pins in full bearing under no load. All the vertical measurements were taken from a datum line as a known elevation scribed on the vertical numbers of the existing trusses before any loads were superimposed.

Erection of the south half of the falsework and arches was carried out with the aid of a 30-ton stiff-leg derrick. This was set up on the south abutments, with the mast approximately on a line with the new end pins. This derrick had 110 ft. of main boom and a 25 ft. jib. The bottom of the mast was set about 15 ft. above the bridge floor level. It was possible from this set-up to erect the south half-arches and the middle top-chord, sway-frame. After this was done the derrick was moved and set up in a similar position on the north abutment and the north half-arches were erected. It was then found that the actual deflections had followed the theoretical very closely, the pinholes being actually 2 in. high. No difficulties were encountered in erecting and pinning the four half-arches. The entire operations, not including the time of setting up equipment and erecting falsework, required barely eight days' work.

Removing the Old Truss.—After the chord splices were riveted, the supporting wedges were pulled, making the arches self-supporting. The needle-beams were then clamped to the new bottom chords and to the supporting beams on the old structure. It was possible, in this way, to support the old superstructure from the new arches, using the same system of needle-beams as were used in erection. Starting at the center the old steel superstructure was then cut out piece by piece with acetylene

Placing Last Diagonal Member in East Arch—April 19, 1935

Placing Last Member in West Arch—April 19, 1935

torches. The new hangers, floor-beams, and stringers were filled in as the portions of the old trusses were removed.

Conclusion.—At the present writing the structural steel is entirely in place, and the contractor is proceeding with the paving of the approaches and the concrete deck slab. A dedication ceremony is planned for July 3.

General contractors on the Ashmun Street bridge are Fry and Kain, Inc., and Robert Hudson, of Lansing, with A. H. Fry in charge of the work. Fabrication and erection of structural steel was sublet to the Lackawanna Steel Construction Corporation of Buffalo.

The Michigan State Highway Department is represented as follows: L. W. Millard, Bridge Engineer; J. H. Cissel, Engineer of Bridge Design; J. H. Flynn, Engineer of Bridge Construction; P. A. Nordgren, Project Engineer.

The writer is indebted to E. J. Olney and M. M. Anderson for valuable assistance in the preparation of the above article.

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More "Stop" Signs on Minnesota Trunk Roads Likely

Speeding motorists on trunk highways usually can be brought to a complete stop in built-up districts and other danger zones easier than they can be slowed down to a safe gait, it is indicated by experiments conducted by the Minnesota highway department.

Some engineers who have been studying the reactions of drivers to various types of warning signs believe that the future may see much trunk highway traffic brought to a complete stop at the edge of populated districts, and then permitted to proced at a reasonable speed, says a Minnesota highway department bulletin.

The department is also considering bringing traffic to a full stop when entering zones were crews are at work on the roads. Failure of drivers to slow down sufficiently when warned to do so has resulted in death and injury to several road workers this season.

The experiments show that if a motorist driving at high speed on the open road slows down 10 miles an hour he has the sensation of going quite slowly, although he still may be making 50 or 60 miles an hour. However, if he comes to a complete stop and then starts up again, by the time he reaches 25 or 30 miles an hour he has a sensation of considerable speed.

Therefore, in several towns where "slow" signs on trunk routes have failed to stop accidents, the experiment has been tried of bringing all traffic to a full stop. It then proceeds at a reasonable speed. The experience indicates that in many cases this method will prove successful when others fail.

EFFECT OF PAVEMENT WIDTHS UPON ACCIDENTS

By ROGER L. MORRISON

Professor of Highway Engineering and Highway Transport, University of Michigan

IT has been stated that the standard width of 20 ft. for two-lane pavements is needed only because they are used by large trucks and buses, and that a width of 18ft., or less, would be sufficient for passenger automobiles. This conclusion is based upon vehicle widths and clearances and a study of the actual positions occupied by vehicles upon pavements of various widths.

Since the largest vehicles permitted by law, in most states, are 8 ft. wide, it is obvious that, if they are driven carefully, all classes of vehicles can pass each other upon an 18-ft. pavement, and the only reason for a 20-ft. pavement is added safety. Also it seems obvious that the only true measure of safety is to be found in accident records, but this has apparently not been considered in the various discussions which have been published. Perhaps the reason is that accident records of pavements of various widths are not readily available.

In 1932 a study was made of the motor vehicle accidents which occurred in Washtenaw County, Michigan, during 1931. While the effect of pavement widths was not particularly considered at the time, the report includes data which throw considerable light upon that subject. The main object of the present investigation was to find evidence bearing upon the desirability of building 20-ft. pavements for passenger automobiles.

There are four roads in the county carrying a daily traffic of from 2,600 to 3,600 vehicles each, three of them being 20 ft. wide and the other 18 ft. Also there are two roads with a daily traffic of 1,700 to 2,100 vehicles. One of these is 20 ft. wide and the other averages about 15 ft. wide.

The 20-ft. pavement in the first group are U. S. 23—M 17 between Ann Arbor and Ysilanti, 5 miles long between city limits; U. S. 12 east of Ann Arbor, approximately 10 miles long to the county line; and U. S. 112 west of Ypsilanti, 19 miles long from there to the county line. The 18-ft. pavement is U. S. 12 west of Ann Arbor, about 19 miles long to the county line.

First Comparison.—The first comparison will be between the 5-mile U. E. 23—M 17 and the first 5 miles of U. S. 12 west of Ann Arbor. These two roads are similar as to vertical and horizontal alignment. The 20-ft. pavement, which has been widened to 30 ft. since this investigation was made, is concrete, and the 18-ft. pavement is asphalt. The traffic volume on the former is 3,500 vehicles per day and on the latter it appears to be about the same at the Ann Arbor city limits, decreasing to 2,600 vehicles 13 miles from the city.

There were 19 accidents reported on U. S. 23—M 17 between Ann Arbor and Ypsilanti. In one of these a car was hit by a train, three were pedestrian accidents, one was at an intersection, and two were cases of vehicles (one a truck with trailer) skidding into the ditch, no other vehicle being involved in either case. None of these seven accidents appeared to have been affected by the pavement width, thus leaving only 12 for further consideration. The causes of these accidents, and similar ones on other pavements, are shown in Table II.

There were 23 accidents reported on the 18-ft. U. S. 12 pavement within 5 miles of the Ann Arbor city limits. One was caused by a loose horse, four were due to left turns at intersections, and one was caused by attempting a right turn too fast. These apparently were not affected by pavement width, leaving 17 accidents for further consideration.

Second Comparison.—A second comparison may be made between the 20-ft. U. S. 12 east of Ann Arbor, about 10 miles to the county line, and the first 10 miles of the 18-ft. U. S. 12 west of Ann Arbor. The former, known as the Plymouth Road, passes over a number of hills and is considered especially dangerous. The daily traffic on this road averages 3,600 vehicles at the Ann Arbor city limits and probably does not decrease any as it approaches Plymouth, on the way to Detroit.

There were 22 accidents reported on this road. One was a pedestrian accident, one was caused by loose horses, one involved a truck making a left turn, in one case a truck hit a car pulling onto the pavement, three automobiles and one truck ran off the road, in one a Ford truck was parked on the pavement without lights, one car was found in the ditch with a dead man and an injured man inside, the cause of the accident being unknown, and in one case no description was given. Eliminating these 11 accidents leaves 11 in which pavement width was probably a factor.

To compare an equal length of 18-ft. pavement with the Plymouth Road the accidents on the second 5-mile section were investigated, and it was found that the number reported was 16. Two trucks and two automobiles ran off the road, due in some cases to the driver being asleep. One bus ran off the road and struck a guard rail, this being the only bus accident of any kind recorded on any of the roads. In one case a speeding car hit the rear end of a truck going in the same direction, and in two cases, one involving a fatality, no description is given. This leaves eight accidents probably affected by pavement width.

Third Comparison.—A third comparison can be made between the 20-ft. U. S. 112 (Detroit-Chicago Road) between Ypsilanti and the county line, about 19 miles, and an equal length of the 18-ft. U. S. 12 west of Ann Arbor. The terrain through which these two roads pass is similar and the traffic volume is about the same

Twenty-nine accidents were reported on U. S. 112 from Ypsilanti west to the county line. There were two or three more the location of which was uncertain, but the indications were that they were on U. S. 112 east of Ypsilanti. Two of the 29 accidents involved pedestrians, 3 were at intersections, 2 were due to left turns, 1 was a rear-end collision, 6 ran off the road, 1 hit a wagon with no lights, 2 skidded and rolled over on wet or icy pavement, and in 1 case the cause was not given. This leaves only 11 accidents in which pavement width appeared to be a factor.

Ten accidents were reported on the last 9 miles of U. S. 12 between Ann Arbor and the county line west.

Two of these involved pedestrians, and in a third a tire blew out and the car went in the ditch. The other seven cases were probably affected by pavement width.

Fourth Comparison.—A fourth comparison may be made between a narrow road M 132, from Ann Arbor to Dexter, 7 miles long, and the first 7 miles of U. S. 23 running north from Ann Arbor. The latter is a 20-ft. concrete pavement and the former is gravel with a bituminous surface varying from 14 to 16 ft. in width. These roads are not more than 7 miles apart at any point in the sections under consideration and both lead to lake resorts, though U. S. 23 is also a trunk line to the northern part of the state. The average daily traffic on M 132 is 1,800 vehicles near Dexter, and 1,700 about half way to Ann Arbor. It probably is a little heavier near Ann Arbor, but traffic counts at that point are not available. The average traffic on U. S. 23 is 2,000 vehicles at the end of the 7-mile section and 2,100 a couple of miles nearer Ann Arbor. It is probably much greater near Ann Arbor, as the first 2 miles passes through a suburban residence district. U. S. 23 was paved about seven years ago, while M 132 has never had much improvement except for the surface treatment.

Five accidents were reported on the first 7 miles of U. S. 23 north of Ann Arbor. One was at an intersection and another appears to have been at an intersection also, though details are lacking. In a third case the steering knuckles failed on a speeding car, causing it to roll over the pavement. This leaves two accidents, both involving passenger cars only, which might be affected by pavement width. In one case a car was on the wrong side of the road and the other case was a "side-swipe" in passing the car ahead.

The accident situation on the Dexter Road was rather surprising. It has been termed "ideal for accidents" and nine accidents were reported, but five of them were at intersections and two cars skidded and ran off the road. Of the two remaining accidents, one was a collision, with no details given, and the other occurred when a car ran into the ditch to avoid a head-on collision in passing a car ahead.

The comparison of accidents on these two roads is readily apparent from this brief description. The traffic volume and nature, and the characteristics of the roads are different from the others under discussion, therefore they will be eliminated from further consideration.

Accidents Not Affected by Pavement Width.—Table I shows the distribution between the 20-ft. and the 18-ft. pavements of the accidents which are believed not to have been materially affected by pavement width.

The 36 accidents occurred on 34 miles of 20-ft. pavement, giving an average rate of 0.94 accidents per mile, while the 17 accidents occurred on 19 miles of 18-ft. pavement, giving an average rate of 0.90 accidents per mile.

This close check is further evidence that these accidents were not materially affected by pavement width. If the three overlapping sections (the first 5 miles, the first 10 miles, and the whole 19 miles) of U. S. 12 are considered as three separate roads, then the figures become 36 accidents on 34 miles of 20-ft. pavement and 37 accidents on 34 miles of 18-ft. pavements.

Accidents Affected by Pavement Width.—Table II gives the types and locations of the accidents in which the pavement width appeared to be a factor.

TABLE I.—ACCIDENTS NOT AFFECTED BY PAVEMENT WIDTH

	—Width— 20-ft.	18-ft.	Total
Ran off road—some drivers asleep	12	5	17
Pedestrian accidents	6	2	8
Left turns at intersections	3	4	7
Other intersection accidents	4	0	4
Rear end collisions	2	1	3
Skidded on wet or icy pavement	2	0	2
Hit loose horses	1	1	2
Made right turn too fast	0	1	1
Hit car coming onto pavement from shoulder	1	0	1
Hit a wagon with no lights	1	0	1
Hit by a train	1	0	1
Tire blew out	0	1	1
Cause unknown	3	2	5
Total	36	17	53

TABLE II.—ACCIDENTS AFFECTED BY PAVEMENT WIDTH

	20-ft. pavement				18-ft. pavement			
Type of accident	U.S. 23—M 17	U.S. 12 east	U.S. 112	Total	1st 5 mi. U.S. 12 W.	2nd 5 mi. U.S. 12 W.	Last 9 mi. U.S. 12 W.	Total
Side-swiped in passing	1	1	1	3	6	3	2	11
On wrong side of road, passing car ahead or otherwise	2	4	6	12	3	3	4	10
Collision—details lacking	3	2	2	7	2	..	..	2
Skidded into another car	1	2	..	3	2	1	..	3
Vehicle parked partly on pavement	2	1	..	3	1	1	..	2
Car ahead stopped or swerved forcing following car to turn out and hit third car	2	..	..	2	2	..	1	3
Ran off pavement to avoid collision	1	1	1	3	..	..	..	..
Struck bridge	..	..	1	1	1	..	..	1
Totals	12	11	11	34	17	8	7	32
Accidents per mile of pavement	10							1.7
Increase 18-ft. over 20-ft. rate, per cent								70

TABLE III.—ACCIDENTS AFFECTED BY PAVEMENT WIDTH ON BASIS OF 34 MILES OF 18-FOOT PAVEMENT

	20-ft. pavement	18-ft. pavement
Side-swipe in passing	3	26
On wrong side of road, usually in passing car ahead	12	19
Collisions, details lacking	7	6
Skidded into another car	3	8
Vehicle parked partly on pavement	3	5
Car ahead stopped or swerved	2	7
Ran off pavement to avoid collision	3	0
Struck bridge	1	3
Total	34	74
Accidents per mile of pavement	1.0	2.2
Increase 18-ft. over 20-ft. rate, per cent	..	220

Table III is a summary of Table II with the three overlapping sections of U. S. 12 considered as three separate roads totaling 34 miles in length, the same as the 20-ft. roads.

The method used in Table III, while fictitious in that the accidents in the first 5 miles of the 18-ft. pavement are counted three times, and those in the second 5 miles twice, is believed to constitute a more accurate comparison than that used in Table II. This is because the traffic conditions on the 18-ft. and 20-ft. pavements are by no means comparable unless the three over-lapping sections of U. S. 12 are considered as three roads.

It is evident that there are many more accidents on the 18-ft. road than on the 20-ft. roads, with comparable traffic, and the next question is whether the acci-

TABLE IV.—TRUCK AND AUTOMOBILE ACCIDENTS AFFECTED BY PAVEMENT WIDTH

	Pavement width			
	20-ft.		18-ft.	
	trucks	autos	trucks	autos
Side-swiped in passing	0	3	2	23
On wrong side of road	4	8	6	13
Collision, details lacking	0	7	3	3
Skidded into another car	0	3	0	8
Vehicle parked partly on pavement	3	0	5	0
Car ahead stopped or swerved	1	1	1	6
Ran off pavement to avoid collision	0	3	0	0
Struck bridge	0	1	0	3
Total	8	26	18	56

dents are caused mainly by trucks or by passenger automobiles. As previously stated, there were no buses involved in any of these accidents, although all the roads considered carry bus lines. Table IV shows the truck accidents separately.

This table shows that there was an increase of 10 truck accidents, or 125 per cent, on the 18-ft. pavement as compared with the 20-ft. The automobile accidents increased by 30, or 116 per cent—three times as large an increase, in number, as for trucks.

All accidents in which a truck was involved in any way are entered in the table as truck accidents, although a passenger car was also involved in every case, and usually the driver of the car was at fault. In a number of cases the fact that a truck was hit was merely because it happened to be the first vehicle to come along when a passenger car was running wild.

Unfortunately there is very little information as to the width of the trucks involved, and no exact statements of width. It can only be inferred, in some cases, from the make or type of truck mentioned. If every truck not specifically designated as a Ford or Chevrolet should be assumed to be 8 ft. wide they would still account for only a small per cent of the increase in accidents on the narrow road as compared with the wider roads.

Nature of Truck Accidents.—Following is a brief description of the truck accidents affected by pavement width:

U. S. 23—M 17 (20-ft.).—In two cases the truck was parked partly or entirely on the pavement, while in the third case "a Packard sedan, going east, stopped suddenly in front of a Chrysler coupe also headed east. The driver of the Chrysler turned to the left to avoid a collision and hit a Ford truck going west."

U. S. 12 east (20-ft.).—The two accidents were caused when automobiles attempted to pass trucks, one involving a head-on collision with another car and the other a drunken driver who ran into the ditch.

U. S. 112 (20-ft.).—One report states that a speeding car hit the truck as the car turned out to pass, and the other states that a car on the wrong side of the road hit a truck.

First 5 miles of U. S. 12 west (18-ft.).—In one of these cases a truck crashed into the rear end of a sheriff's car parked on the pavement because of another accident. In the second case a "truck and trailer, going west, hit Buick, going east. Buick skidded crossways and was struck in center." The official report of the third truck accident says, "Driver of Ford was trying to pass a milk truck and went way over to the left side of the road and struck a culvert; then glanced off and hit a tree head-on. Driver had smell of whiskey on his breath. One pint bottle of whiskey was found in the car, contents half gone." One person was killed and three were injured in this accident. One may speculate as to whether or not two more feet of pavement width would have prevented this wreck, but the answer is very obscure. In the fourth truck accident, "a Chevrolet coach, going east, skidded into a swaying trailer. A Ford coupe, also going east, put on brakes and front end skidded into a truck. . . ."

Second 5 miles of U. S. 12 west (18-ft.).—In one case "a Buick hit a truck on the truck's side of the road," and another involved three trucks (two parked) and two cars.

Last 9 miles of U. S. 12 west (18-ft.).—In one of the cases a truck was hit by an automobile which was on the wrong side of the road, and in the other case a truck swerved to the left as an automobile was trying to pass it from the rear.

Basis of Comparison.—It is rather difficult to determine how the data obtained in this investigation should be arranged in order to make the comparisons necessary for drawing conclusions. They have been arranged in various ways in the preceding tables, but it seems logical first to separate the heavily traveled U. S. 12, U. S. 112, and U. S. 23—M17 from the two 7-mile roads carrying lighter traffic. It is unfortunate that there was only one 18-ft. pavement to compare with three 20-ft. pavements of different characteristics, but since each 20-ft. pavement is similar in characteristics to one of the overlapping sections of the 18-ft. road, it seems logical to consider each of these as a separate road. That gives a theoretical total of 34 miles of 18-ft. pavement to compare with the 34 miles of heavily traveled 20-ft. pavement.

Economic Aspects.—In order to determine the economic aspects of traffic lane widths it is necessary first to determine accident costs. In 1924 the National Conference on Street and Highway Safety, in estimating the economic loss due to traffic accidents, put the cost of a fatality at $5,000, a personal injury at $175, and average property damage at $50. There are about 35 personal injuries to each fatality. Vehicles involved in rural accidents are usually traveling at high speeds, so that the average property damage in a rural accident is greater than in a city accident. Investigations in two cities indicated an average property damage of $20, and it is possible that the rural damage averages $100, or more, but actual statistics on this do not seem to be available.

Also it is highly probable that the ratio of fatalities to personal injuries is higher in rural accidents. On the roads covered in this investigation the ratio was about 1 to 10 in the accidents reported, but on the other hand, all fatal accidents are reported while there are doubtless many minor personal injury accidents which are not reported. The same is true of accidents involving property damage only.

In order to work out the economic justification of wider traffic lanes, upon the basis of accident costs, it is necessary to study the records for a number of years so that actual relationships can be determined, otherwise one or two bad accidents may distort the picture. For instance, in a recent accident on a county road three persons were killed outright and four were seriously injured. As this is written two of the injured are not expected to live. If they do recover, the estimated cost of the accident would be about $16,000, but if they do not recover it would be nearly $26,000. The difference would equal the cost of the 100 non-injury accidents at $100 each, which is almost half as many accidents as were reported in the whole county in a year.

This great distortion, due to chance location of very severe accidents, might be eliminated by estimating the

cost of the "average" accident and then using this cost in every case.

A set of statistics at hand shows the following relationships for rural accidents: Total accidents, 190-710; killed, 13,050; injured, 214,100. This is a ratio of about 16.4 injured to 1 killed. A ratio of 1 to 20 seems reasonably accurate, so it may be assumed that the cost of 20 average accidents is as follows:

1 fatality at $5,000	$ 5,000
20 injuries at $175	3,500
20 property damages at $100	2,000
Total	$10,500

Dividing this sum by 20 gives an average cost of about $500 per average reported accident.

Upon the roads studied in this investigation there were 30 more accidents on the 18-ft. than on the 20-ft. pavements, considering only those accidents affected by pavement width. At $500 each this is a total of $15,000, or about $450 per mile. This should easily cover the annual cost of two extra feet of pavement width.

Obviously when more or less arbitrary assumptions are made in evaluating various factors, the accuracy of the results is open to question, but the important matter is the method of attack. If that is logical, then the accuracy of results will increase as more statistical data become available.

Conclusions.—The data presented in this report appear to indicate that:

1. There are more accidents on 15-ft. and 18-ft. pavements than on 20-ft. pavements carrying similar traffic.
2. The greatest per cent increase is in "side-swipe" accidents.
3. Buses are very seldom involved in accidents.
4. The percent increase in truck accidents and non-truck accidents is approximately the same.
5. The increase in the number of non-truck accidents is much greater than the increase in truck accidents.
6. The additional cost of accidents on the 18-ft. pavement appears to be greater than the annual cost of an additional 2 feet of pavement.

From these items it is evident that wider pavements are needed much more because of passenger automobile accidents than because of truck and bus accidents.

Of course, this is merely a bit of evidence based upon only 115 accidents occurring on three 20-ft. roads, one 18-ft. road, and on 14-ft. to 16-ft. roads. Further studies in other locations may contradict it, but it seems too consistent to be refuted merely by opinions or computations, unsupported by actual accident data. It is hoped that a method of approach has been suggested which will be adopted, or improved, by other investigators.

The foregoing is a paper presented before the Highway Research Board.

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The Ohio State Highway Testing Laboratory

A few days ago the field editor of ROADS AND STREETS called at the Ohio State Testing Laboratory located at the Ohio State University at Columbus. Unfortunately his time was limited, and the most which could be done was to hit the high-spots under the guidance of one of the very competent assistants of Mr. R. R. Litehiser, Chief Engineer of the Bureau of Tests. Here are some of the things the editor saw and noted.

A three story, concrete frame, brick walled building of pleasingly substantial appearance, having a floor area of about 25,000 square feet.

A very complete set of offices (both executive and operating) with library and all up-to-date equipment. An inter-communicating telephone system, independent of the main board, added convenience.

A well-equipped cement laboratory.

A large moist-curing room, maintained automatically at 70 degrees Fahrenheit and 100 per cent relative humidity. The arrangement of racks permitted the storing of a large number of specimens in convenient and accessible positions at all times.

An aggregate laboratory for the testing of concrete and bituminous aggregates, and also soils for foundations and backfill. Much more attention is being given now than formerly to this latter subject, and the work of the laboratory is being expanded accordingly.

A bituminous laboratory for testing asphalts, tars, and all other bituminous materials used in road construction. The work here includes both chemical and physical tests.

A chemical laboratory for the testing of paints, metals, and other products, as may be necessary.

Ohio State Highway Testing Laboratory

A sound-proof rattler room with refrigerator type door and celotex ceiling. Although this room adjoins the concrete laboratory, the noise of the tests is in no way disturbing. Similarly, the modified abrasion test is sound-proof and operates without annoyance to persons near by.

A Waukesha CFR fuel testing unit located in a penthouse. This unit, or engine, is a delicate piece of apparatus for the determination of the octane ratio of gasolines and other fuels.

A freezing and thawing laboratory in which tests are made on concretes and cement mortars. One-half a standard cylinder (6 in. diameter by 6 in. high) is the usual specimen for a concrete test. Mortar specimens are 2 in. cubes. Sometimes as many as 150 cycles of alternate freezing and thawing are given before a specimen fails. This work is largely of a pioneering character and standard methods have not yet been developed.

The laboratories contain much fine new equipment as well as some old stand-bys which have given satisfactory service for many years. The building was erected in 1932 from plans by Howard Dwight Smith, University Architect, based on outlines submitted by Mr. Litehiser. The editor still hopes for an opportunity to go through with sufficient leisure to observe the tests in detail.

THE NEW "CHANGE ORDER" FORM OF OHIO STATE HIGHWAY DEPARTMENT

A NEW change order form adopted about April 1st of this year by the Ohio Department of Highways has proved exceedingly satisfactory both to state engineers and to contractors. It is printed on letter size sheets with provisions on the front for listing the changes and giving the reasons, and with the back left blank except for a two-line heading, the intention being that it shall be used for supplemental specifications when necessary. However, the back is probably most often used to carry over the explanation of items on the first page.

The old form which was displaced measured 9x6 inches, and was not only an inconvenience in filing but failed to afford sufficient space for writing in many instances. The back was occupied by a set of instructions and therefore was not available. Not only does the new sheet give sufficient space for explanations and calculations, but it saves time in both the division office and the central office and adds convenience in checking final reports and final estimates.

C-77 Rev
ORIGINAL
Chief Engineer of Bureau

STATE OF OHIO
DEPARTMENT OF HIGHWAYS

CHANGE ORDER No. 1

(Each change order must pertain to one proposal only and must be numbered consecutively for each proposal.)

County Erie Fed. No. State Project
S. H. 965 Section E
Prop No. 3 Cont. No. 9852

PROPOSED ADDITIONS OR NON-PERFORMANCE IN CONNECTION WITH CONTRACT ITEMS*

Ref. No.	Item No.	Location	Quantity	Unit	Description	Unit Price	Additions	Non-performance
1	E-1	86/12 to 87/62	55	Cu.Yds.	Roadway Excavation-unclassified	0.35	19.25	
2	I-1	90/56	20	Lin.Ft.	12" Corrugated Metal Pipe for driveways	1.25		25.00
3	E-2	94/27	15	Cu.Yds.	Excavation for structures-unclassified	1.00	15.00	
3	S-1	94/27	10	Cu.Yds.	Concrete for structure	15.00	150.00	
4	S-4	94/27	144	Lbs.	Reinforcing steel	0.04	5.76	
						TOTALS	$190.01	$25.00

PROPOSED ITEMS FOR EXTRA WORK CONTRACT

*Item over-runs exceeding $2000 or 20% of the original amount of item shall be listed below, together with any contingency items.

3	E-2	94/27	7.5	Cu.Yds.	Excavation for structures unclassified	1.00	7.50	
5	S-18	65/52 to 66/27	500	Lin.Ft.	8" Concrete filled steel casing piling in place	2.00	1000.00	
						TOTALS	1007.50	

EXPLANATION OF NECESSITY FOR ABOVE ITEMS

1. Removal of solid rock at subgrade elevation.

2. Driveway to be abandoned by property owner.

3. Additional excavation required due to uneven surface of rock under north abutment.

4. Error in plans. K bars in east wing omitted in steel summary.

5. Piling necessary to protect roadway amount of slide which has developed on right side of cut during recent wet weather.

6. (see reverse side) Contractor is unable to obtain suitable cinders and has therefore requested permission to use limestone chips at bid price. No additional charge to be made.

I hereby agree to perform the additional work and extra work contract items and to the non-performance of work as listed above in accordance with any supplemental specifications or special provisions which may be written on the reverse side of this sheet.

Smith Brothers
(Contractor)
By John Smith June 17 193 5
(Date)

Requested Ben Johnson (Engineer) June 17 193 5 (Date)
Approved A. B. Jones (Division Engineer) June 17 193 5 (Date)
Approved John Doe (Chief Engineer of Bureau) June 18 193 5 (Date)

NOTE: If the general specifications are inadequate to govern performance of the additional work and extra work contract items listed above, write supplemental specifications or special provisions on the reverse side of this sheet.

Front

SUPPLEMENTAL SPECIFICATIONS OR SPECIAL PROVISIONS TO GOVERN THE PERFORMANCE OF WORK WHEN GENERAL SPECIFICATIONS ARE INADEQUATE

6. Permission is hereby granted to use limestone chips in lieu of cinders in the construction of foot walk between Stations 101/65 and 102/98 at no additional cost to the State.

Back
Change Order

The form is used for all changes in bid items, contingency items, changes in specifications, supplementary specifications, requests for time extensions, changes in location of items, and in general, for any change in the contract, and for new contract items.

Six copies of each change order are made, and are distributed as follows: 1. Chief Engineer of Construction. 2. Auditor of State Department of Highways. 3. U. S. Bureau of Public Roads. 4. The Contractor. 5 The Division Engineer. 6. Engineer in charge. Paper of six different colors, on which these forms are printed, readily distinguishes one copy from another.

The Division Engineer is permitted to authorize changes not exceeding $250.00 in amount. Changes exceeding $250.00 in amount, all contingency items, all extensions in time, and all changes in location of items, must be authorized by the Chief Engineer of Bureau. Shown herewith are examples of typical change orders on the new form.

The treatment of the item "Excavation for structures —unclassified" under Reference No. 3 illustrates some of the more complicated details in the use of the form. The contract item was 75 cu. yd., but was overrun 22.5 cu. yd. The Ohio law permits an overrun in any individual item of not to exceed 20% of the item or $2,000.00 in cost. Twenty per cent of 75 cu. yd. is 15 cu. yd., which item is shown as an addition.

the balance of 7.5 cu. yd. being carried necessarily as an extra work contract item.

The explanation of Ref. No. 1, "Removal of solid rock at subgrade elevation," and the unit price of 35c per cu. yd. may be confusing to people not familiar with Ohio practice. Highway excavation in Ohio is not classified. In this case the bid for unclassified was 35c, and the added quantity necessarily takes the same rate.

The following instructions are bound with each block of forms:

"INSTRUCTIONS GOVERNING THE USE OF CHANGE ORDERS

"All additions, non-performance, extra work contract items, supplemental specifications and special provisions must be authorized by properly executed change orders. Six copies of each change oder shall be executed.

"In general, proper execution shall consist of the signatures of the contractor, the Division Engineer, and the Chief Engineer of Bureau. After the change order has been signed by the contractor and the Division Engineer all six copies should be forwarded to the Chief Engineer of Bureau for his consideration. If the change order is approved the last three copies will be returned to the Division Engineer for distribution as indicated.

"When the work in question does not involve over $250.00 *and contract unit prices apply,* the work may be authorized by the Division Engineer. In such cases proper execution shall consist of his signature and that of the contractor. The first three copies of the executed change order should be forwarded immediately to the Chief Engineer of Bureau and the last three copies should be distributed as indicated.

"If the general specifications are inadequate to govern performance of work, supplemental specification or special provisions should be written on the reverse side of the change order.

"A complete explanation of the necessity for each change order item must be given. The back of the form may be used if it is not required for the purpose indicated in the heading, or supplemental 8½x11 sheets may be used.

"Each change order must pertain to one proposal only and must be numbered consecutively for each proposal.

"The Division Engineer shall not approve estimates involving additions, non-performance, or extra work contract items unless properly executed change orders authorizing them are on file."

▼

PENNSYLVANIA INCREASES GAS TAX.—On July 1 a bill went into effect increasing the gasoline tax in Pennsylvania from 4 ct. to 5 ct. a gallon, including the 1 ct. federal tax. The entire increase will be diverted from highways. Present plans call for the use of this money for relief during the next twelve months. After that date it will be used to defray the general administrative expenses of the state.

C-77 Rev.
ORIGINAL
Chief Engineer of Bureau

STATE OF OHIO
DEPARTMENT OF HIGHWAYS

County Erie Fed. No. State Project
S. H. 965 Section D
Prop No. 2 Cont. No. 9852

CHANGE ORDER No. 3

(Each change order must pertain to one proposal only and must be numbered consecutively for each proposal.)

PROPOSED ADDITIONS OR NON-PERFORMANCE IN CONNECTION WITH CONTRACT ITEMS*

Ref. No.	Item No.	Location	Quantity	Unit	Description	Unit Price	Additions	Non-performance
						TOTALS		

PROPOSED ITEMS FOR EXTRA WORK CONTRACT

*Item over-runs exceeding $2000 or 20% of the original amount of item shall be listed below, together with any contingency items.

						TOTALS		

EXPLANATION OF NECESSITY FOR ABOVE ITEMS

(1) Unsuitable weather conditions:
Rain, snow and mud 23 days.

(2) Other unfavorable conditions not caused by Contractor's negligence.
None.

(3) Acts or delays in acting by the State of Ohio.
Concrete pouring stopped by order from central office to await second approval of material - 4 days.

(4) Net extra work after deducting all non-performance.
None
(23/4) / 10 days = Total 37

NOTE: 10 days added in accordance with Section C-8.06 of General Specifications.

(over)

I hereby agree to perform the additional work and extra work contract items and to the non-performance of work as listed above in accordance with any supplemental specifications or special provisions which may be written on the reverse side of this sheet.

Smith Bros.
(Contractor)
By John Smith May 14 1935
(Date)

Requested Ben Johnson (Engineer) May 15 1935 (Date)
Approved A. B. Jones (Division Engineer) May 16 1935 (Date)
Approved John Doe (Chief Engineer of Bureau) May 18 1935 (Date)

NOTE: If the general specifications are inadequate to govern performance of the additional work and extra work contract items listed above, write supplemental specifications or special provisions on the reverse side of this sheet.

Front

SUPPLEMENTAL SPECIFICATIONS OR SPECIAL PROVISIONS TO GOVERN THE PERFORMANCE OF WORK WHEN GENERAL SPECIFICATIONS ARE INADEQUATE

For the reasons stated on the front of this sheet we request an extension of time in the completion date of our contract of 30 working days, changing the completion date June1st, as called for on our contract, to July 8th, 1935.

Back

Request for Extension of Time

Book Reviews

Two Publications on Timber and Its Use

Wood Structural Design Data by R. G. Kimbell, A. T. Upson, M. Ahern. Published by National Lumber Manufacturers Association, 1337 Connecticut Avenue, Washington, D. C., 294 pages, 8½x11, $1.00 per copy.

This volume contains the most complete and convenient set of timber design tables which the writer has seen. In addition to these, there are chapters on the chemical properties of woods and other subjects of a character not ordinarily given with structural tables. In short, the designer here has between two covers information which formerly would have required reference to several different sources. Some of this information, in fact, has never before been presented in tabular form. All kinds of wood are covered, but no attempt is made to influence the user's choice among them.

The table of contents is as follows:

During the preparation of the book Mr. Kimbell consulted with many architects and engineers to ascertain their opinion of what information was most needed and how it might be presented for the maximum convenience of the designer and the technical professions. Publications and information from the Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, and standard works on mechanics of materials were used as sources of information. Timber quality-strength relations are based on information contained in U. S. Department of Agriculture Miscellaneous Publication No. 185, the paper in which the principles of the structural grading of timber were first authoritatively set forth.

A spiral wire binding permits the opening and folding back of the book at any place so that it occupies only the space of one letter size sheet when lying open on the table.

A glossary of lumber terms and a list of abbreviations which are common parlance in the lumber trade are given. A table of board measure shows the board feet content for various nominal sizes of lumber of various lengths in feet. This is followed by a table whereby an estimator may readily convert the price per thousand feet to the cost per piece or per quantity. An explanation of the sizes of American Standard yard lumber and timber is followed by definitions of the technical notations and symbols used in the balance of the book.

The character of the structural tables is well illustrated by the case of beams, which are covered in two general groups: one in which the load is limited by the stiffness or the resistance of the beam to deflection, and the other set by the strength of the beam in bending. These tables give the safe loads for most combinations of stress, size, and spans encountered in the structural use of wood. They give the safe uniform loads, both total and per linear foot of span, with a series of factors by which they can be converted to other loading conditions. Further, the tables are based on American Standard Dressed Sizes (S4S), and another series of factors are given whereby the data can be converted to rough sizes and dressings other than S4S.

The most conspicuous departure from the ordinary methods of presenting technical data occurs in these beam load tables. As architects and engineers have pointed out, the desirable span is usually the first thing determined in designing a structure and then a search must be made to find a beam size which will support the expected load over that span. On this account the load tables are given under headings of span lengths for the various sizes of beams. For example, if the desired span is 10 feet, the designer, under the table for that span and under the stress for the wood he wants to use reads down until a tabular load equal to or greater than the load to be carried is found, and opposite that load is the minimum size of beam which should be used. To assist the designer in selecting the most economical size, the tables give the load carried per board foot of beam and also give the board foot content of a beam of the length involved. It is apparent that by referring back to the previously mentioned table of lumber quantity costs a designer can readily ascertain which size which would be to his advantage to use.

This publication is designated "Volume I." The contents of other volumes to follow is not stated.

▼

Lumber Grade-Use Guide. Published by National Lumber Manufacturers Association, 1337 Connecticut Ave., Washington, D. C. A series of loose-leaf pamphlets, each dealing exclusively with the species of woods from a particular region or division of the industry. Price complete, $1.50.

This Guide answers the question of the selection of lumber needed in a structure of any kind. Reference to it will show the species and grades recommended, with standard sizes, for framing, joists, subflooring, flooring, sheathing, interior trim, exterior wall covering, and, in fact, all the lumber items required for a building or structure. The Guide deals, in all, with 22 individual kinds of softwoods, 33 hardwoods, and 26 different broad types of buildings and other structures.

One index covers "Kinds of Wood" and the other "Kinds of Structures." The first tells in which pamphlet is to be found the desired species; the second gives the number of the table in any pamphlet containing specific grade recommendations for the purpose intended. These tables are numbered serially from 1 to 26, and a table covering a given structural purpose bears the same number in each species pamphlet. Some tables are omitted from certain pamphlets because the species concerned are not generally used for that particular purpose.

▼

City Population in California Per Mile of Street.—Road stransportation surveys made by the California Division of Highways show the average population per mile of street for all cities of the state is 235.

▼

State to Conduct Tourist Census

How many tourists come into Minnesota, where they are from and where they go while here will be determined by a traffic study starting this week under the supervision of the state highway department and the state tourist bureau. The work has been set up as a relief project financed largely by the SERA. About 160 relief workers have been assigned to the project, which will continue for probably 60 days.

EDITORIALS

How to Increase Unemployment?

THE intent of the Emergency Relief Appropriation Act of 1935 was to increase employment. It defeats its own purpose, at least as far as the highway field is concerned, by the restriction that for every $1,400 expended on a project one man must be taken from the relief rolls and furnished work directly on the job for one year. This sum also is to provide all necessary construction material, equipment and transportation for the same period.

This means that a large part of this year's $200,000,000 highway appropriation may have to be expended by the state for day labor for road grading and drainage and that a minimum of equipment will be employed in this work. In other words, the old pick and shovel period of our great grandfathers has been restored by a scratch of the pen.

Now the ruling requires that one man be employed directly on the job for one year. But there is considerable difference between the calendar year and the grading year, in some states as much as 200 days. For instance, in New Hampshire the average number of working days for road grading is only 140. In northern Minnesota it is 150 days. Killing frosts come early and late in those and many other states—late in the spring and early in the fall. How then is this one man to get in a full year directly on the job in those states where it is possible to work at grading operations only from 140 to 180 days? But this we assume is a mere minor detail in the plans of the Works Administration that can easily be solved by the same arithmetical exercise as was used in solving (?) the unemployment problem: Divide 3,500,000 men to be put to work into $4,000,000,000 to be expended.

The $1,400 ruling practically eliminates the construction of heavy traffic roads under the $200,000,000 appropriation. These roads require that materials and equipment be transported from outside the location of the work, and thus furnishes employment directly to many men other than those directly engaged on the job. The same is true of low cost roads, where outside materials and equipment are used. It is estimated that for every man directly on the job there are two men behind him engaged in the production of machinery, equipment and materials and their transportation. If the work is limited to grading and drainage by manual labor as this $1,400 restriction would seem to require, it simply means that for every man put directly on this job two men that ordinarly would be employed in the shops and in the material plants and in the pits and quarries would not secure jobs.

Fortunately this $1,400 ruling does not apply to the $125,000,000 Federal Aid appropriation which became available on July 1. Nor, as we understand it, does it apply to the $100,000,000 appropriation from the Hayden-Cartwright act of 1934 which was allotted to the states in June. It does not apply to the state funds that will be used to match the $125,000,000 Federal Aid appropriation, and the additional state funds that will be used for construction. Thus $400,000,000 to $500,000,000 will be available for construction purposes by the states and this work can be handled as it has been in previous years.

▼

Why Forest Protection Roads Should Be Built Under the Direction of the Forest Service

AMONG federal relief projects are "protection roads" in more than 150 National Forests that average a million acres each. These protection roads are not public highways, but, as their name indicates, are roads that enable the foresters to transport their fire-fighting forces and equipment quickly. The location and building of these roads has always been under the direction of foresters and engineers in the Forest Service. Hence they have acquired an invaluable experience in this sort of work. Rumor has it that this experience and the organization that possesses it may not be utilized to the fullest extent, but that some new agency—probably SERA—is to be put in charge of the construction of these "protection roads." The editors of ROADS AND STREETS believe that any such plan would be a serious mistake.

Should it be argued that SERA will not locate the roads but will only build them, it should be replied that the best of builders is usually the man who has had the longest experience as a manager of building the type of construction under consideration. On this score the Forest Service organization is unquestionably the one to whom this job should be assigned.

The President has said that politics must play no part in relief projects. On this score also the Forest Service is above reproach. Its employees in responsible positions are civil service executives, and while it will be necessary greatly to increase the number of those executives and their engineers, still the organization will remain under the control of the Chief Forester and his District Foresters—men of long experience and proven ability. Moreover, the overhead expenses will be less under them, because of the existing nucleus of executives and engineers.

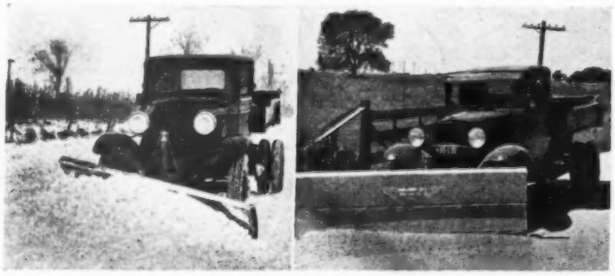
Forest protection roads are costing from $3,000 to $4,000 a mile. Judging by the frequent inefficiency of many of "the alphabetical organizations" in charge of public works, a cost much higher than this is to be expected if SERA handles the job.

Although the primary object of relief work is to replace doles with wages, still it is desired to secure as many miles of roads as possible. This goal is attainable only under experienced, efficient management, free from political wire-pulling and the fear of losing office if the behests of politicians are ignored. We doubt whether any large group of government executives is more independent than those of the Forest Service. We know that no group is so well equipped with knowledge and so seasoned by experience needed to manage the building of forest protection roads.

NEW EQUIPMENT AND MATERIALS

Truck Tool for Year Round Use

A truck tool designed for use as a road maintainer, road plane and snow plow has been placed on the market by the Anthony Co., Inc., Streator, Ill. In winter this truck tool can be used for plowing snow and is stated to plow to a full 30 in. mould board depth. The patented Meyer safety blade permits higher speed snow removal, for it readily hurdles any ordinary road obstruction such as rocks, manhole covers, etc., without the use of springs and gadgets. The swinging mould board can be instantly set to cast snow to the right or left, or for bulldozing.



The Anthony Truck Tool

In summer the unit can be used for grading rock on highways. The chatter-proof blade is stated to plane a smooth surface at any usable speed. The mould board can be swung to the right or left for side casting or to full clockwise position for light bulldozing. The 8 ft. blade clears an ample path for dual wheels to follow. The mould board is 30 in. high and the height of the lower half of the mould board is 18 in. and the length of the mould board is 8 ft.

▼

New Austin-Western Hydraulic Scraper

This large capacity, 12-yd. scraper, which introduces several interesting features of construction, digs, loads, hauls and dumps more, at a faster rate, according to the Austin-Western Road Machinery Co. of Aurora, Ill.

Constructed throughout of special alloy steel, to make it lighter in weight but stronger, and welded, this self-contained scraper carries its own motor, hydraulic pump and primary control apparatus The only connections between tractor and scraper are the drawbar pin and a small electrical cable (with quick release attachment plug). With this obstruction and arrangement, the entire output of tractor power is devoted to pulling the scraper, and tractor can be disconnected for other work in less than two minutes' time.

A "remote" form of control, extremely easy to manipulate, is employed. This consists of small electrical push-down switches, positioned at operator's elbow, that actuate hydraulic valves, located on scraper, to control all digging, carrying and unloading. Scraper has open top for loading with shovel or elevating grader if desired.

Four hydraulic rams in all are used to raise and lower pan, raise and lower front gate, and for moving back of pan forward to unload. Load is forced out, not dumped. Wheels are equipped with Timken bearings and 13 5x20 in. pneumatic tires. Frame is supported at three points to obtain greater flexibility and strength. Front axle and pole are rigidly connected and have ball and socket at king post.

New Light Weight Portable Excavator

A new light weight portable excavator and loader is now being offered by Chadwick Machinery Co., 25th and Clybourn Sts., Milwaukee, Wis. It is powered with a 30-H.P. gasoline engine and built on four-wheel chassis, with scraper capacity of from ¼ cu. yd. size up to ½ cu. yd.

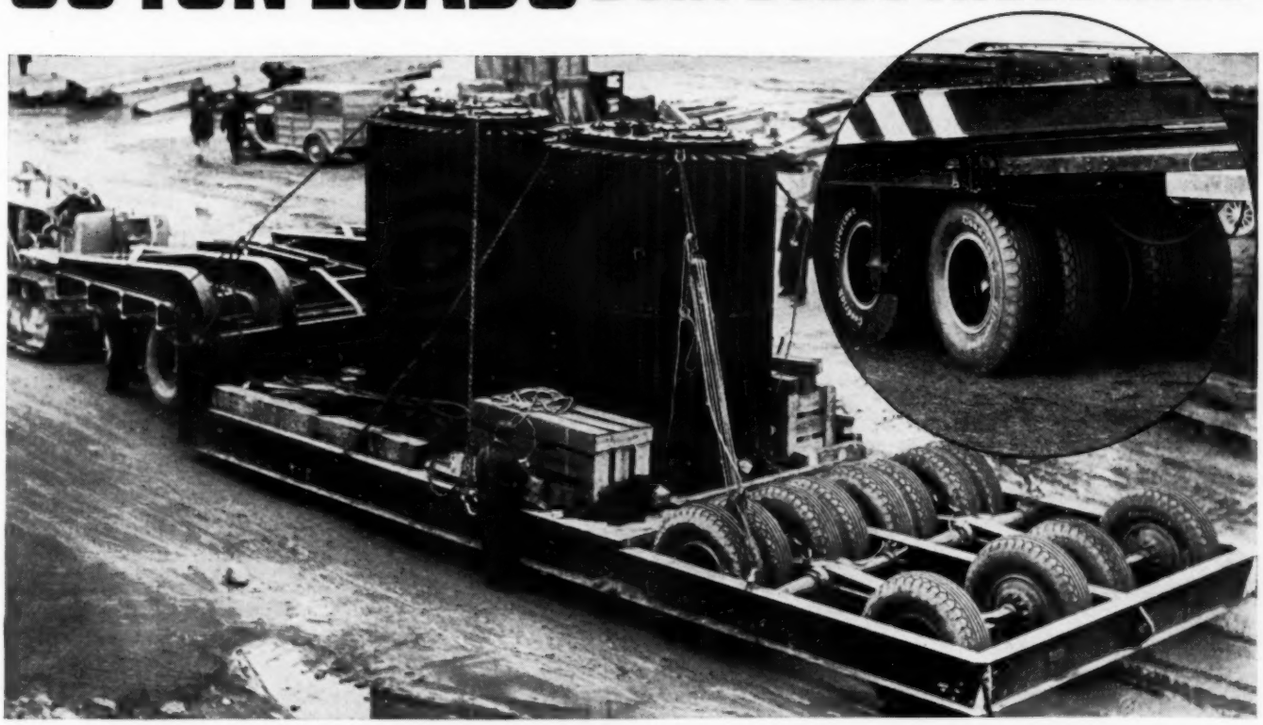
The machine is entirely automatic in operation, having a governor on the engine and having provision for a complete automatic cycle of loading and unloading scoop. Additional feature is a separate line control to stop and start machine at any time desired.

Light Weight Excavator

This excavator is mounted on pneumatic tires, with solid tires optional. The weight of the machine is about 3,500 lb., and the fact that machine is mounted on wheels with automotive steering and tongue permits easy moving of machine from job to job behind any small truck or passenger car.

New Austin-Western 12-Yd. Scraper

80-TON LOADS *Don't Scare These Tires*



NEW TYPE TRUCK TIRES USED ON GIANT 20-WHEEL TRAILER AT GRAND COULEE DAM

They had a tough transportation problem at Grand Coulee Dam. Heavy equipment and materials had to be hauled 30 miles or more over rough roads to the site of the dam. It takes a crawler tractor to supply the power!

So the contractor built what is believed to be the world's largest trailer. Built for loads up to 60 tons. The trailer itself weighs 20 tons.

To carry this gigantic load they use the new Triple Protected Silvertowns—the tires that have proved themselves on the hardest hauling jobs in the country!

These new truck tires have a revolutionary invention incorporated in the sidewall. The invention actually checks 80% of premature failures. It means that tires stand up longer under the battering, bruising punishment of construction work.

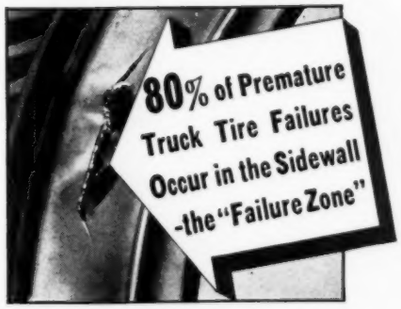
Tires that carry 80-ton loads at Grand Coulee will handle *your* job right, too!

One tire failure on an important job may cost you hours of delay—men and equipment idle—a big repair bill. Why not play safe? Get the tire that's just as strong in the sidewall as it is under the tread! Here's how triple protection works:

1 **PLYFLEX**—a *new*, tough, sturdy rubber material with greater resistance to stretch. A layer of Plyflex in the sidewall prevents ply separation—distributes stresses—checks local weakness.

2 **PLY-LOCK**—the new Goodrich way of *locking* the plies about the bead. Anchoring them in place. Positive protection against the short plies tearing loose above the bead.

3 **100% FULL-FLOATING CORD**—Each cord is surrounded by rubber. With ordinary cross-woven fabric, when the cords touch each other, they rub—get hot—break. In Silvertowns, there are no cross cords. No friction.



FREE! 44-PAGE HANDBOOK FOR TRUCK OPERATORS

Every truck owner, every driver should have this big 44-page handbook. Gives commodity weights, tire load capacities, inflation schedules, dual spacing chart, load analysis and other useful information. No obligation. Write for free copy. Dept. T-46, The B. F. Goodrich Company, Akron, Ohio.

Goodrich *Triple Protected* Silvertowns

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES

New Patch Roller

A new general utility roller having portability as one of its outstanding features, has been brought out by the Galion Iron Works & Manufacturing Co., Galion, O. The roller can be attached quickly to a truck and the roll raised off the ground by means of a hydraulic lift, and thus can be transferred from place to place at truck speed.

The motor, transmission and compression roll are mounted in a sub-frame hinged at the back to the main frame by a large cross shaft mounted in bronze bushings and supported at the front by a yoke which is attached to the hydraulic ram used for raising and lowering the sub-frame.

Ample size locking pins with retainers are supplied for supporting the sub-frame when raised for towing, and the same pins lock the sub-frame to the main frame when the roller is being operated. When the towing tongue is attached to the towing cross-member of the truck and sub-frame raised for towing, ample clearance of from 8 to 9 in. is provided under the compression roll.

Galion Portable Patch Roller

The power plant consists of a high efficiency 4 cylinder motor equipped with air cleaner, magneto with impulse starter, governor and fan. The motor is fully enclosed and protected. The gear case is also fully enclosed and operates on friction reducing bearings in an oil bath. Fuel consumption of this power plant for normal rolling conditions in ½ gal. per hour.

The hydraulic lifting device for raising and lowering the sub-frame is mounted on the right-hand front corner of main frame close to the ram so that the length of pressure hose is kept to the minimum. The hydraulic pump is hand-operated and a valve is provided for changing from raising to lowering and vice versa. The ram for raising and lowering the sub-frame consists of an efficient double acting hydraulic cylinder. Connections are flexible high pressure tubing.

The steering axle is so mounted as to provide a wide range of oscillation on the center pin, which permits the operator to roll close to curb with one wheel riding on top of curb. Provision has been made to lock the oscillaing feature of the axle and to lock the steering gear with the wheels straight with frame for towing.

Provision has also been made to secure the steering gear lock so it will be inoperative when the roller is working. Heavy duty 32 in. by 6 in. tires are used on the wheels.

The weight on the compression roll is 5,000 lb., which can be increased to 7,300 lb. by adding water to the roll. The rolling width is 42 in. The roller has speed of 1.5 m.p.h. in low and 5 m.p.h. in high. The wheelbase is 72 in.; the tire tread, 54 in., and the length overall without towing tongue is 10 ft. 6½ in. The turning radius is 12 ft. 9 in. to outside.

New Blueprinter

A new model of the Angstrom lamp blueprinter has been announced by Milligan & Wright Co., 4672 Prospect Ave., Cleveland, O. This one is a floor model with a novel arrangement for the washing and fixing trays and drying boards provided in the base. The floor space required is only 28 in. by 30 in.

The equipment utilizes an incandescent lamp as light for blueprinting and is stated to produce prints with exposures of ¾ to 1½ minutes, depending upon the drawing and paper used. The time switch which cuts off the current at the end of the exposure selected further simplifies the operation. Model 200 has a capacity of one 18x24 or several smaller prints at one time.

▼

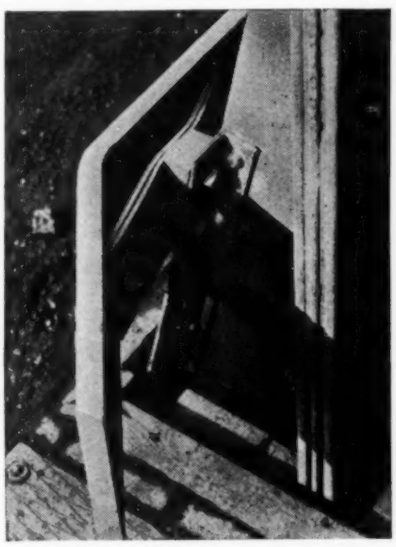
New Steel Guard Rail

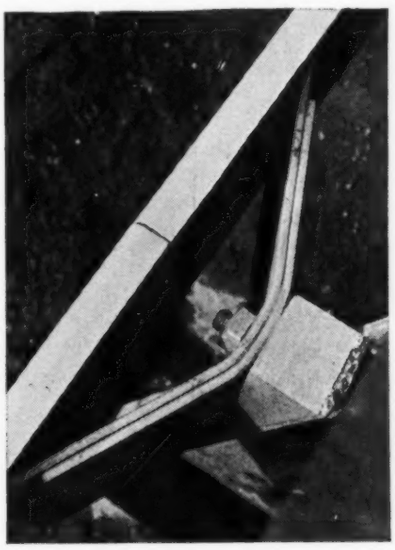
A new rolled steel guard rail has been brought out by the Rex Road & Bridge Guard Co., 5540 Harrison St., Pittsburgh, Pa. Although designed essentially for protection of bridge members as well as traffic, its use is not necessarily so restricted.

The guard consists of rolled steel channels or formed sections of variable thicknesses. Flexibility is provided by the back support, which involves either one or two flat spring steel sections, the latter in turn bolted to the bridge members.

In the fabrication of the guard rail either a rolled channel or formed plate section is used in lengths to correspond with bridge panel lengths and spliced with countersunk bolts. At the joints, bent spring steel flats are so set as to absorb collision shock with the outer guard member. The springs in turn are bolted to the bridge members, or, as in the case of deck bridges, the guard may be fixed to posts of malleable iron or spring steel.

Several methods of adjusting the spring steel flats have been recommended. The standard method is to form eyes on each end of the spring leaf into which round steel pins of about 1 in. diameter are fixed, extending beyond each side of the spring about 1 in. These pins are set into slotted holes about 6 in. in length. The slots are in lugs, which are fastened, either by riveting or welding, to the guard.





Mounting of Guard Rail on Supporting Posts, at Joints

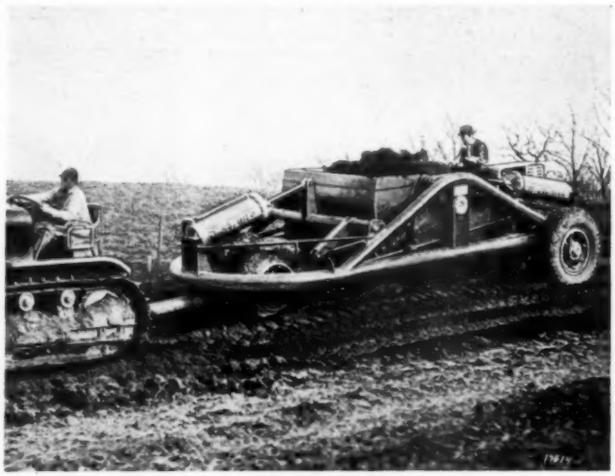
▼

Deane Now Handling Sales Tuthill Guard Rail

Richard F. Deane, C.E., formerly with the American Bridge Co., is now handling guard rail sales for Tuthill Spring Co., Chicago. Substantial installations of the guard rail are now being erected in Illinois and Indiana, these being repeat orders.

Air-Powered Scoop

An air-powered scoop having a capacity (self-loading) of 10 cu. yd. has been placed on the market by the Midwest Piping & Supply Co., Inc., 1450 South Second St., St. Louis, Mo. The depth of cut and of spread as well as the dumping are controlled by air power. The scoop has a maximum depth of cut of 12 in., a bowl clearance in carrying position of 18 in., a maximum dumping angle of 90 degrees, and a depth of spread of 0 to 25 in. The wheelbase is 15 ft. 2 in., the overall length 23 ft. 6 in., the overall



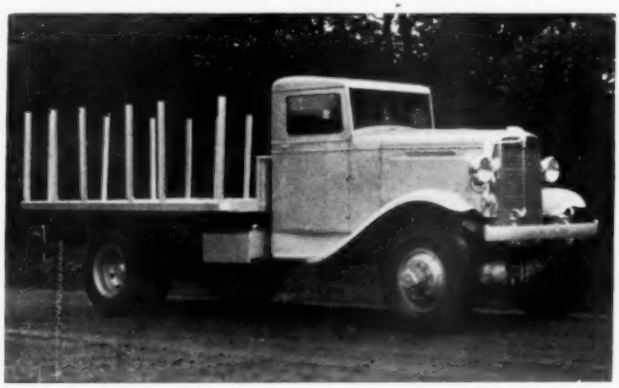
Midwest-Patterson Air-Powered Scoop

width with outside rear wheels in place 11 ft. 6⅜ in. The length of cutting blade is 7 ft. The cutting edge is alloy steel. The weight is 16,500 lb. The bowl is made of high tensile steel and heavily reinforced; all welded construction. The frame is welded from seamless steel tubing, and serves as an air reservoir, having 125 lb. air pressure always available for inflating tires or for other purposes. The gas engine and air compressor (both air-cooled) and air equipment are all standard units.

▼

New Line of All-Wheel Drive Trucks

A new and complete line of 4 and 6-wheel-drive motor trucks, ranging in gross capacity from 8,400 to 52,000 lb., has been announced by the Marmon-Herrington Co., Inc., Indianapolis, Ind., manufacturers of all-wheel-drive trucks exclusively.



New Marmon-Herrington Model B70-4 Truck

The initial announcement of the line includes 21 models. Thirteen of these models are 4-wheel-drive vehicles, 10 with gasoline engines and three with Diesel engines. The remaining eight models are 6-wheel-drive units and of these eight, five have gasoline engines and three, Diesel engines. The 4-wheel-drive models range in gross capacity from 8,400 to 31,200 lb. and the 6-wheel-drive models from 26,500 to 52,000 lb.

Each model is engineered so that it can be manufactured in two or more wheelbase lengths and equipped with tires of two or more sizes. Thus an almost unlimited number of units is available—each fitting a definite purpose by giving just the right com-

bination of size, weight and carrying capacity for the job for which it is intended.

Throughout the entire line, both engine size and power have been increased. The Diesel engines which are available on numerous models are the latest type available and have established outstanding records in performance and economy. Many refinements have been made in chassis, and the Marmon-Herrington front axle construction has been ever further improved in efficiency and simplicity.

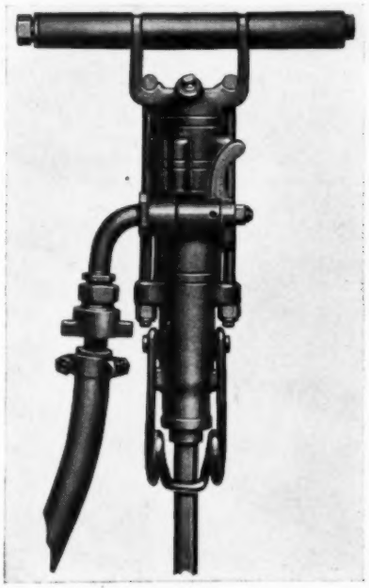
One of the outstanding features of the new line is the low center of gravity, lateral stability and all-round safety of all models. Frame heights have been lowered. Dual rear wheels are standard equipment, while auxiliary as well as standard transmissions are built into all models—even the smaller sizes.

New radiator designs and a number of other improvements in exterior appearance have been made, and the new line is looked upon as being far ahead of the all-wheel-drive in style and modern lines. Ease of handling and comfort for driver and passengers likewise have been given special attention.

▼

New Light Sinker Drill

A new light sinker drill, designed particularly for shallow drilling in soft to medium formations, has been placed on the market by the Chicago Pneumatic Tool Co., 6 East 44th St., New



New CP-22 Sinker (Dry)

York. The machine is stated to have exceptional drilling speed, rotative strength, and hole-cleaning capacity, considering its size and weight. The specifications follow:

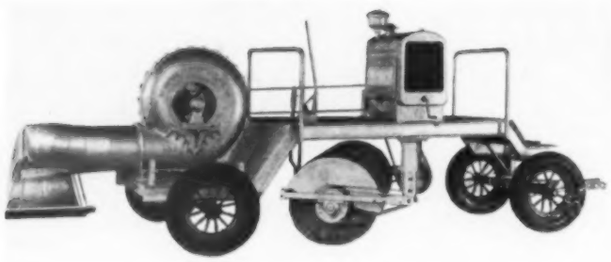
Description.	CP-22 dry	CP-22W wet
Type		
Net weight, lb.	28	32
Overall length (with retainer), in.	19⅞	19⅞
Economical drilling depth, ft.	6—8	6—8
Size of hex. drill steel shank, in.	⅞ x 3¼	⅞ x 3¼
Size of air hose, in.	¾	¾
Size of water hose, in.		½

▼

New Sweeper-Blower

To meet the requirements of those state highway departments which now demand, on bituminous surface treatment contracts as well as on retread paving, that the road surface be cleaned by air as well as swept, the Frank G. Hough Co., 919 North Michigan Ave., Chicago, has recently placed on the market a new Universal sweeper-blower. This machine, embodying the same principles as their Universal road sweeper, is a combination machine which both sweeps and blows at the same operation.

Built on a heavy I-beam chassis and mounted on Timken bearing pneumatic tire wheels, this machine is operated by a 30-H.P. heavy-duty type Hercules engine equipped with oil type air cleaner and all other accessories. The blower is a No. 8 Champion whose impeller is mounted on a ball bearing shaft and is driven



New Universal Sweeper-Blower

direct from the engine. The nozzle is scientifically designed to deliver the biggest volume of air at the best pressure efficiency, and is adjustable to meet all working conditions.

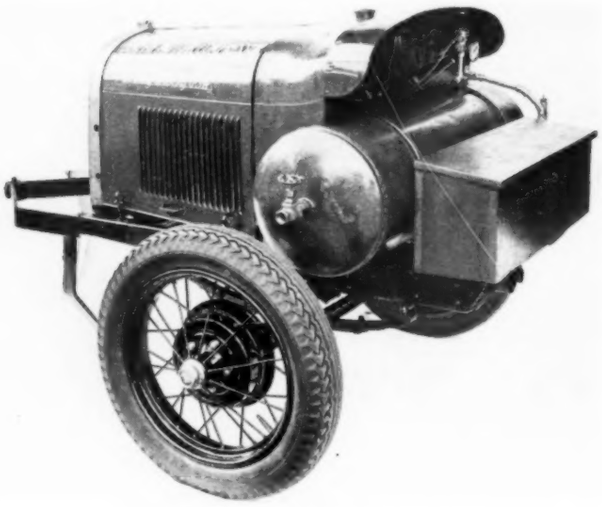
▼

Air Compressor from Ford Parts

A compressor head that makes it possible to build an air compressor by utilizing a Ford motor has been placed on the market by Gordon Smith & Co., Inc., 1220 State St., Bowling Green, Ky. The head is furnished with high speed compressor valves. The accompanying illustration shows a full automatic self-driven compressor using Model A Ford parts wherever possible. It is equipped with motor governor, pilot valve and unloader cylinders for automatic loading and unloading at any desired pressure.

The Ford frame, radiator, motor, and cowl with instrument panel are used. The starter button, switch, ammeter, gasoline gauge, choke, pressure gauge and pilot valve are all arranged in the most convenient location. The battery sets in one end of the handy tool box back of the tank.

The air receiver, size 16 in. by 44 in., has two ¾-in. openings near the ends on the back side, one ½-in. opening in the bottom and one 1¼-in. opening for the discharge line from the compressor. This line enters through the dash just over the steering post slot. Receiver is held in place by two ⅜-in. U-shaped rods over the tank and through the frame.



Air Compressor Built from Ford Parts

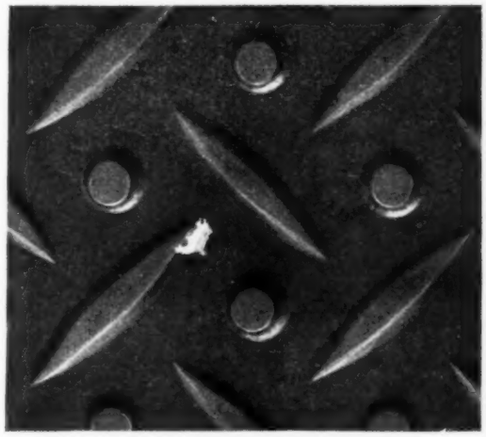
Ford axle has wheel spindles welded in rigid position.

Tow connection is 5/16-in. by 3-in. iron with 2-in. by 10-in. pipe sleeve welded in narrow section; 1½-in. pipe leg slides in 2-in. sleeve.

The compressor has a 60 cu. ft. capacity.

"All-Way-Grip" Pattern Floor Plate

A new pattern added recently to the line of non-skid rolled steel floor plates of the Central Iron & Steel Co., Harrisburg, Pa., is illustrated below. This is known as the "All-way-grip" pattern



Central "All-Way-Grip" Patterns

and it employs the same units in intermediate size to the "knobby" and "knobbyette" patterns of the company. However, the units are realigned to angle instead of vertical axis.

The design matches equally well on sides or ends, providing maximum economy and minimum wastage in shearing. Each diamond projection centers the next one at right angles, and the exclusive knob offers additional resistance and protection against slippage.

▼

Improved Paving Material

An improved paving material, known as Downard Rock Asphalt, is now being manufactured and marketed by The Interstate Amiesite Co., Wilmington, Del. This material is made of a hard and tough mineral aggregate, 95 to 100 per cent of which passes a No. 4 sieve, which, when properly laid, will produce a watertight and non-skid pavement.

The mineral aggregate is coated with a hard and a soft asphalt, which after amalgamation, produces a cement of high melting point and a low cold point, which is proof against softening in warm weather and against cracking in cold weather.

This material is largely used for resurfacing and sealing old macadam, concrete and brick roads, which, when properly done, affords a fine safe-traction surfacing of long life, at small cost per square yard, and maintenance-free for numbers of years. It is usually applied at from 30 to 40 sq. yds. per ton of material. It may in case of skin patching or in sealing retread construction, be applied as thin as 80 sq. yds. per ton. This material may be laid either by hand or by machine.

▼

WITH THE MANUFACTURERS

Beggs Now Advertising Manager Toncan

Robert C. Beggs has been appointed advertising manager of the Toncan Culvert Manufacturers' Association, Youngstown, O., succeeding H. N. Pickett. Mr. Beggs has had a long and varied experience in the advertising field.

▼

Charlotte, N. C., to Install New Traffic Signals

Mr. B. Atwood Skinner, Chief Building and Safety Inspector for the city of Charlotte, N. C., has just received shipment of 40 electric stop and go signal housings and brackets complete; these electric signals are of the latest improved type for erection on sidewalks and are to replace some of the old type center suspension type signals in the uptown district. It is Mr. Skinner's intention to gradually replace all the center suspension type signals throughout the city with the sidewalk bracket type signals. The signals were purchased of the Essco Manufacturing Co., Peoria, Ill., through their sales representatives, T. L. Pitts & Son, Charlotte, N. C.

New Representatives Homestead Valve Manufacturing Co.

Homestead Valve Manufacturing Co., Coraopolis, Penn., announces the following new exclusive representatives for the sale of their chemical vapor spray cleaning unit, Hypressure Jenny: W. T. Walsh Equipment Co., 3088 West 106th St., Cleveland, O.; Albon Tractor Co., 725 East 25th St., Baltimore, Md.

▼

Organization Changes U. S. Rubber Co.

The United States Rubber Products, Inc., New York, announces the following organization changes: W. S. Long, formerly manager mechanical sales in the Seattle district, has been transferred to the Los Angeles district as manager mechanical sales at that point. C. W. Gilmer, formerly salesman in the San Francisco district, has been appointed manager mechanical sales, Seattle district.

▼

New Distributor for Bucyrus-Erie

Bucyrus-Erie Co., South Milwaukee, Wis., announces the appointment of Joseph Kesl Tractor & Equipment Co., 1510 North 13th St., St. Louis, Mo., as its distributor in the eastern portion of Missouri and the southern part of Illinois. The Joseph Kesl Tractor & Equipment Co. will handle Bucyrus-Erie machines ranging from ⅜ to 2-yd. capacity—shovels, draglines, cranes, clamshells, dragshovels and skimmer scoops.

▼

Petter Supply Co. Appointed Link-Belt Shovel, Crane Distributors

Announcement is made by Link-Belt Co., Shovel and Crane Division, Chicago, of the appointment of Henry A. Petter Supply Co., Paducah, Ky., as their distributors of Link-Belt crawler-mounted shovels-cranes-draglines, and track-type locomotive cranes. The company is headed by Stanley D. Petter and for 45 years has served the needs of contractors and industrial plants within a radius of 150 miles of Paducah.

▼

C. E. Bement Is Dead

Clarence E. Bement, an outstanding figure in the industrial world for more than 25 years, died June 9 at his home in Lansing, Mich., at the age of 79. In 1907 Mr. Bement founded the Novo Engine Co. of Lansing and up until 1932 was in active charge of the company in the capacity of vice-president and general manager. At this time he retired from active duty to accept the chairmanship of the board of directors, which position he held at the time of his death.

Mr. Bement was an active figure in many national manufacturers' associations, holding various offices. He also was elected to the office of president of the Michigan Manufacturers' Association. Tribute is due this pioneer of modern industry for the contribution his progressive thinking and steadfast integrity has made to the industrial world.

▼

Personnel Changes in G. E. Organization

Changes in the executive personnel of the apparatus engineering and sales organization of the General Electric Co., effective July 1, have been announced as follows: Commercial engineering activities of the transportation department and general office commercial transportation activities will report to Vice-President H. L. Andrews, who will become a member of the apparatus sales committee. Industrial commercial engineering will hereafter report to W. W. Miller, manager of the industrial department, and contral station commercial engineering to M. O. Troy, manager of the central station department of the company. Vice-President E. W. Allen will be a member of the apparatus sales committee, Mr. Swope announced, and will have supervision of the contract service department and in addition will assist the district offices in all phases of their work. Vice-President E. O. Shreve will continue as executive representative of the company in the National Electric Manufacturers Association, and is appointed chairman of the apparatus sales committee, which will direct the general commercial policies of the apparatus departments of the company.

U. S. Forest Service Purchases 239 Adams Graders

The sale of the new type leaning wheel graders of J. D. Adams Co. got off to an auspicious start recently when the U. S. Forest Service ordered 108 12-ft. machines with power operated controls and 109 10-ft. blade machines with power controls. In the order were also included 22 graders No. 121 with power controls. Most of the machines, totaling 239 purchased in one order, have either been shipped or are waiting shipping instructions. It is understood that the machines will be used largely in new CCC camps being established.

▼

J. G. Barry, G. E. Vice-President, Retired

The retirement of John G. Barry, senior vice-president of the General Electric Co., after more than 45 years of service, and his election to an honorary vice-presidency, was announced by President Gerard Swope following the meeting of the board of directors held in New York on June 28. Mr. Barry, as active head of the apparatus sales organization, has for many years formulated and executed the company's policy and sales program in the apparatus field. He will maintain an office in Schenectady and will be available for consultation. The retirement is effective as of July 1.

▼

Earl C. Smith, First Sales Manager of Osgood, Dies

The Osgood Co., Marion, O., announces with deep regret the death of Mr. Earl C. Smith, the first sales manager of Osgood, and who has been continuously identified with the company since 1910. Mr. Smith was among the pioneers to advance the use and distribution of the revolving type shovels, and in his earlier years was recognized as an authority on steam shovel operation and use. Some of the largest railroad type shovels in America were placed by Mr. Smith, and his activities during more than 25 years with the Osgood Company covered every section of the world where excavating machinery was used. Mr. Smith was born in Marion County, Ohio, and was 55 years of age. He was stricken with meningitis a few days ago and died very suddenly on June 11.

▼

Calumet Steel Now Subsidiary of Borg-Warner

All the capital stock of the Calumet Steel Co. of Chicago Heights, Ill., has been purchased by Borg-Warner Corporation and now operates as a separate Borg-Warner subsidiary. Roy C. Ingersoll is the new president of the Calumet company. Mr. Ingersoll is a director of Borg-Warner Corporation and president of the Ingersoll Steel & Disc Co. Division of Borg-Warner Corporation. F. G. Carrel, formerly secretary of Calumet, was named vice-president and Mathew Keck was elected as secretary and treasurer. Directors of the Calumet Steel Co. are R. C. Ingersoll, F. G. Carrel, S. L. Ingersoll, Frank Matthiessen and C. S. Davis.

It is contemplated that in the near future the membership of the board will be enlarged to include, with others, Harold G. Ingersoll.

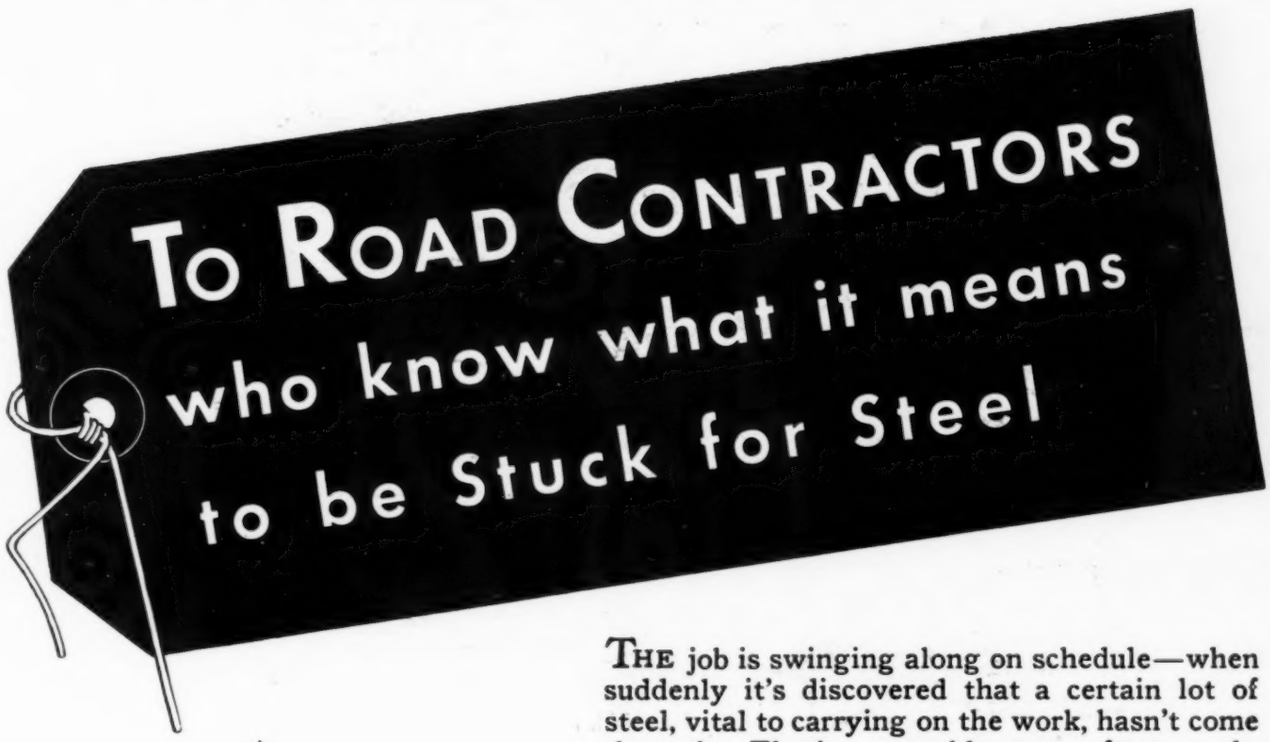
▼

Penn-Dixie Announces Promotions in Operating and Engineering Staff

Felix Guenther, Jr., has just been appointed Chief Engineer of Pennsylvania-Dixie Cement Corporation, with headquarters at Nazareth, Pa., and Norman V. Geyer, Superintendent of Plant No. 1, at Kingsport, Tenn. In making the announcement, W. H. Klein, general operating manager of the corporation, said:

"Mr. Guenther is a graduate of the Case School of Applied Science, Cleveland, Ohio, with many years of experience in the cement industry. For the past nine years he has been general superintendent of our Plant No. 1 at Kingsport, Tenn.; during the ten years preceding, he was general superintendent of the Clinchfield Portland Cement Co., and prior to that had acted in the same capacity for other companies.

"Mr. Geyer graduated in Chemical Engineering from Purdue University in June, 1918. After some experience elsewhere, he joined the Penn-Dixie staff at Kingsport in the capacity of chemist. He was later made assistant superintendent and for some time past has been acting as chief chemist and assistant superintendent at the Kingsport plant."



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Kalman Steel Products for Highway Building

BAR MATS
WELDED WIRE FABRIC
CONTRACTION JOINTS
(Road Strip)
EXPANSION JOINTS
STEEL REINFORCING BARS
MISCELLANEOUS PRODUCTS
DOWELS, DOWEL BAR SUPPORTS
BAR TIES, ETC.
BETHLEHEM STEEL SHEET PILING
BETHLEHEM H PILING
KALGUARD-STEEL PLATE HIGHWAY GUARD

Kalman Distribution Points and District Offices

Albany Atlanta Baltimore Boston Buffalo
Chicago Cincinnati Cleveland
Detroit Houston Milwaukee Minneapolis
New York Philadelphia Pittsburgh St. Louis
St. Paul Syracuse Washington

KALMAN STEEL CORPORATION

SUBSIDIARY OF BETHLEHEM STEEL CORPORATION
GENERAL OFFICES: BETHLEHEM, PA.

Pacific Coast Distributor: Pacific Coast Steel Corporation, San Francisco, Los Angeles, Seattle, Portland, Honolulu.
Export Distributor: Bethlehem Steel Export Corporation, New York.

★

THE job is swinging along on schedule—when suddenly it's discovered that a certain lot of steel, vital to carrying on the work, hasn't come through. That's a troublesome, often costly situation. Most road contractors have been through it at one time or another.

Delays of this kind are almost impossible to avoid when the steel comes from half a dozen scattered suppliers who have to be given shipping schedules and followed up individually.

There's a better way to order road steel—a way that avoids all worry, that saves having to be concerned about road steel from the time it's ordered until you're ready to use it. That way is to utilize Kalman Road Steel Service.

(1) Kalman supplies every kind of road steel. Reinforcing Bars, Bar Mats, Wire Mesh, Road Strip, Expansion Joints . . . everything. All the items needed to build a concrete road in any state.

(2) Kalman maintains eight large, strategically located Distribution Points, making possible quick shipment to any location.

When you order steel for a road project from Kalman, your requirements are co-ordinated, handled as a single unit. No fear about this or that item being delayed. No checking up with half a dozen different suppliers. You save worry and save time when you turn over your steel requirements to Kalman Road Steel Service.

KALMAN ROAD STEEL SERVICE

Yes—We would like you to mention ROADS AND STREETS.

ROADS AND STREETS

with which is merged Good Roads and Engineering and Contracting.
Covering design, construction and maintenance of
HIGHWAYS, BRIDGES and OVERGRADE CROSSINGS

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Vol. LXXVIII AUGUST, 1935 No. 8

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